Attachment 2

EFED Registration Eligibility Decision Chapter

Captan

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

5/26/95

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Transmittal of EFED List A Summary Report for Captan (Chemical #081301) Case #0120

FROM: Mary Frankenberry M. Frankenberry
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (7507C)

THRU: Kathy S. Monk, Acting Chief Kathy S. Monk
Science Integration Staff,
Science Analysis & Coordination Staff
Environmental Fate and Effects Division (7507C)

TO: Larry Schnaubelt, Acting Chief
Reregistration Branch,
Special Review & Reregistration Division (7508W)

Attached please find the following documents for the completed EFED summary report of Captan.

1. EFGWB Science Chapter
2. EEB Science Chapter
3. SACS Reregistration Summary Report

Captan exceeds acute levels of concern (LOC's) for fish at all modeled sites. Repeat applications exceed LOC's for small wild mammals at all modeled sites, while the restricted use and endangered species LOC's for aquatic invertebrates are exceeded for various uses. Mitigation measures aimed at reducing application amounts for these uses may have the potential for lowering risks considerably. If you have any questions concerning this case, please contact Mary Frankenberry at 305-5694.

CC:\ (with SACS Reregistration Summary Report attached)

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List A File

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MEMORANDUM

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FROM: Mary Frankenberry M. Frankenberry
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (7507C)

THRU: Kathy S. Monk, Acting Chief, Kathy S. Monk
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Background

Use Profile

Captan is a broad-spectrum fungicide used to control fungi on a wide variety of field crops, fruits, vegetables, and ornamentals. It is also used as a seed treatment and has had industrial uses as well. The use groups are terrestrial food crop, terrestrial feed crop, greenhouse food, greenhouse non-food, indoor food, indoor non-food, and residential outdoor. Formulations include wettable powder, flowable concentrate, emulsifiable concentrate and liquid-ready to use. Captan may be applied as a dip, slurry, and by ground spray, air-blast, and aerial methods. Multiple applications of captan are common.

Levels of Concern Exceedances

The following are the Levels of Concern (LOC) that are exceeded or which might be exceeded if more definitive information were available:

1. For avian acute risk, there are no definitive risk quotients to compare to the LOCs since definitive LC50s are not available (i.e. no mortality was reported at the highest test levels). Similarly for avian chronic risk, no effects were reported at the highest test level. However, EECs sometimes exceed these levels. Avian dietary and reproduction testing at higher exposures, sufficient to produce definitive toxicity values, would be

needed to provide definitive risk quotients.

2. For small wild mammal acute risk, with a single application, the high acute LOC is exceeded for turf and almonds. The restricted use and endangered species acute LOCs are exceeded for all sites modeled. With repeat applications, the high acute risk, restricted use, and endangered species acute LOCs are exceeded for all sites modeled. Chronic LOCs would be exceeded for all the sites evaluated, since the lowest chronic toxicity values are considerably lower than acute values.

3. The fish high acute risk, restricted use and endangered species acute LOCs are exceeded for all modeled sites.

4. The aquatic invertebrate restricted use LOC is exceeded for the following modeled sites: single foliar turf applications and multiple spray blast applications to almonds, peaches, and blueberries. The endangered species acute LOC is exceeded for all modeled sites, except cherries. Chronic effects to aquatic invertebrates cannot be evaluated until submission of chronic toxicity data.

5. A terrestrial plant risk assessment and full aquatic plant risk assessment will be conducted following submission of specified plant test data. Based on the one aquatic plant test available, high risk and endangered species LOCs are exceeded for the turf and peach uses that were modeled.

A wide range of use sites and rates have been modeled by EFED. The above conclusions would also be appropriate for any other sites to which the model results apply.

Risk Reduction Measures

To reduce terrestrial and aquatic risk would require reducing terrestrial and aquatic exposure, respectively. Exposure can be reduced by, for example, lowering maximum application rates on the labels and/or eliminating or reducing repeat applications and/or increasing treatment intervals. Risk quotients can be reduced in direct proportion to a reduction in the EECs, for the given toxicity values.

As indicated below, there are additional data required to complete a risk assessment. New data may indicate new concerns but would not eliminate existing concerns, since EFED uses the lowest valid toxicity values (i.e., highest toxicity) for risk assessment.

Value of the Additional Information

Environmental Fate

The attached package contains an environmental fate assessment and reviews of environmental fate studies received by EFED. Except for terrestrial field dissipation (164-1), all environmental fate guidelines needed to support terrestrial food and feed crop, indoor non-food, and residential outdoor uses are fulfilled at this time. In order to conduct a more thorough environmental fate assessment to support the decision on the reregistration of captan, EFED recommends that at least one field dissipation study be conducted. This study may confirm laboratory study results. It should address clearly the formation and dissipation of THPI and THPAm, the major degradates, in actual use conditions. Other issues identified in the branch chapter and the attached DERs should also be addressed. The information gained from this study will enable EFED to determine the persistence and potential mobility of THPI and THPAm following multiple applications of captan.

Laboratory and field data appear to describe adequately the fate of parent captan and provide relatively consistent estimates of the rates of formation and decline of THPI. However, since the parent molecule is labile, a more thorough understanding the fate of the major degradation products (which appear to be mobile) is essential before the overall environmental fate profile can be completed. Recurring problems in the field studies, including the lack of adequate monitoring of degradates, limit EFED's confidence in the environmental fate assessment for captan at this time. Additional field data are needed which address the fate of degradates more completely.

Additional data are needed to fulfill the accumulation in confined rotational crops data requirement (165-1). In addition, spray drift data (droplet size spectrum [201-1] and drift field evaluation [201-1]) may be requested to support aerial and/or air blast application methods.

Ecological Effects

As indicated in the ecological effects data table, additional data needed to complete a risk assessment are listed in 14 categories with further data requirements reserved (i.e., pending submission and review of other data) in seven categories. The additional data cover avian testing at levels higher than current studies provide, but emphasize a variety of missing studies for freshwater and estuarine acute and chronic requirements, where levels of concern are most often exceeded in the studies at hand. Finally, more extensive plant testing is required. The attached branch chapter reviews the value of these missing studies in greater detail.

Labeling Requirements for Manufacturing-Use Products (Incl. PR Notice 93-10)

The following label statement is required on all manufacturing-use products:

> This pesticide is toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public water unless this product is specifically identified and addressed in an NPDES permit. Do not discharge effluent containing this product to sewer systems without previously notifying the sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA.

Labeling Requirements for End-Use Products (Incl. PR Notices 93-3, 93-8)

Environmental hazard requires the following labeling statement:

> Seed Treatments: This pesticide is toxic to fish. Do not contaminate water when disposing of equipment washwaters or rinsate.
>
> Other Uses: This pesticide is toxic to fish. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters or rinsate.

Labeling for Endangered Species

No use limitations to protect endangered plant species will be suggested until the OPP Endangered Species Protection Program is complete.

Labeling for Surface Water

EFED does not currently believe that surface water labeling is needed for captan. However, if a decision is made in the future to generate a labeling surface water advisory for captan, EFED recommends the following wording:

> Captan can contaminate surface water through spray drift.
> Under some conditions, captan may also have a high potential for runoff into surface water (primarily via dissolution in runoff water), for several days post-application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas over-laying extremely shallow ground water, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetated filter strips, areas over-laying tile drainage systems that drain to surface water, and areas where an intense or sustained rainfall is forecasted to occur within 48 hours.

C. ENVIRONMENTAL ASSESSMENT

1. Ecological Toxicity Data

EFED does not currently have the data needed to fully assess the hazard of captan to nontarget terrestrial and aquatic organisms.

a. Toxicity to Terrestrial Animals

(1) Birds, Acute and Subacute

In order to establish the toxicity of captan to birds, the following tests are required using the technical grade material: one avian single-dose oral (LD_{50}) study on one species (preferably mallard or bobwhite quail); two subacute dietary studies (LC_{50}) on one species of waterfowl (preferably the mallard duck) and one species of upland game bird (preferably bobwhite quail).

Avian Acute Oral Toxicity Findings

Species	% A.I.	LD_{50} mg/kg	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement*
Northern bobwhite	Tech.	> 2,150	GS0120-045 Beavers, 1985	"practically nontoxic"	Y
Northern bobwhite	50%	> 2,510 (test material)	00151236 Wildlife Int., 1978	"practically non-toxic"	S
Mallard Duck	Tech.	> 2000	GS9999-001 Hudson, et. al., 1984	"practically nontoxic"	Y
Starling	Tech.	> 100	00020560 Schafer, 1972	not definitively established; "moderately toxic" or less	S
Redwinged blackbird	Tech.	> 100	00020560 Schafer, 1972	not definitively established; "moderately toxic" or less	S

*Y=Acceptable (Study satisfied Guideline)/Concur P=Partial (Study partially fulfilled Guideline but additional information is needed)
S=Supplemental (Study provided useful information but Guideline was not satisfied) N=Unacceptable (Study was rejected)/Nonconcur

Avian Subacute Dietary Toxicity Findings					
Species	**% A.I.**	**LC_{50} ppm**	**MRID No. Author/Year**	**Toxicity Category**	**Fulfills Guideline Requirement**
Northern Bobwhite	Tech.	> 2,400	00022923 Hill et al., 1975	not definitively established; "slightly toxic" or less	Y
Japanese quail	Tech.	> 5000	Ibid.	"practically nontoxic"	S
Ring-necked pheasant	Tech.	> 5000	Ibid.	"practically nontoxic"	Y
Mallard	Tech.	> 5000	Ibid.	"practically nontoxic"	Y
Northern bobwhite	Tech.	> 4640	00104686 Fink, et. al., 1980	not definitively established; "slightly toxic" or less	S

These results indicate that the captan test material is "practically non-toxic" to the test species on an acute oral basis when the LD50 is > 2000 mg/kg, and on a subacute dietary basis when the LC50 is > 5000 ppm. When the toxicity values are only known to be greater than a value smaller than these cutoffs, the toxicity category cannot be assigned, since the actual toxicity may fall into one of several categories. The guideline requirements are fulfilled for exposures up to the tested levels. Additional testing with the northern bobwhite and mallard are needed at levels > 5000 ppm because of high EECs (see risk assessment). **(MRID#s GS0120-045; 00151236; GS9999-001; 00020560; 00022923; 00104686)**

(2) **Birds, Chronic**

Avian reproduction studies are required when birds may be exposed repeatedly or continuously through persistence, bioaccumulation, or multiple applications, or if mammalian reproduction tests indicate reproductive hazard. Many captan end-use product labels allow multiple applications per growing season.

Avian Reproduction Findings						
Species	% A.I.	NOEL ppm	LOEL ppm	Endpoints affected	MRID No. Author/Year	Fulfills Guideline Requirement
Northern bobwhite	Tech	1000 ppm	——	——	00098295 Fink, 1980	Y
Mallard duck	Tech	1000 ppm	——	——	00098296 Fink, 1980	Y

The avian reproduction studies indicate that exposure at up to 1000 ppm in the diet does not appear to affect reproduction. The guideline requirements are fulfilled for products with application rates resulting in residues $\leq$ 1000 ppm. Testing at higher levels is needed to assess risk for uses producing residues > 1000 ppm. **(MRID#s 00098295; 00098296)**

(3) **Mammals**

Wild mammal testing is required on a case-by-case basis, depending on the results of the lower tier studies such as acute and subacute testing, intended use pattern, and pertinent environmental fate characteristics. In most cases, however, an acute oral LD_{50} from the Agency's Health Effects Division (HED) is used to determine toxicity to mammals. This LD_{50}, which appears to be the lowest available on technical material, is reported below.

Mammalian Acute Oral Toxicity Findings			
Species	LD_{50} mg/kg	MRID #	Toxicity Category
Rat (small mammal surrogate)	1360 mg/kg	266077	"slightly toxic"

The available mammalian data indicate that captan is "slightly toxic" to the test species on an acute oral basis. **(MRID# 266077)**

(4) **Insects**

A honey bee acute contact LD_{50} study is required if the proposed use will result in honey bee exposure.

Nontarget Insect Acute Contact Toxicity Findings					
Species	% AI	LD_{50} µg a.i./bee	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Honeybee	Tech.	9.8% mortality at 215 ug/bee	00080871 Atkins, et. al., 1972	"relatively nontoxic"	Y
Honeybee	Tech.	> 10	05001991 Stevenson, 1978	"relatively nontoxic"	Y

There is sufficient information to characterize captan as "relatively nontoxic" to honeybees. The guideline requirement is fulfilled. **(MRID#s 00080871; 05001991)**

b. **Toxicity to Aquatic Animals**

(1) **Freshwater Fish**

In order to establish the toxicity of a pesticide to freshwater fish, the minimum data required on the technical grade of the active ingredient are two freshwater fish toxicity studies. One study should use a coldwater species (preferably the rainbow trout), and the other should use a warmwater species (preferably the bluegill sunfish).

Freshwater Fish Acute Toxicity Findings					
Species	% A.I.	LC_{50} ppm a.i.	MRID No.	Toxicity Category	Fulfills Guideline Requirement
Bluegill sunfish	90	0.31	GS0120-042	"highly toxic"	Y
Bluegill sunfish	88.4	0.072	00057846	"very highly toxic"	Y
Fathead minnow	88.4	0.065	Ibid.	"very highly toxic"	Y
Brook trout	88.4	0.034	Ibid.	"very highly toxic"	Y
Rainbow trout	90-100	0.073	GS0144-012	"very highly toxic"	Y
Coho salmon	90-100	0.138	Ibid.	"highly toxic"	Y
Chinook salmon	90-100	0.057	Ibid.	"very highly toxic"	Y
Cutthroat trout	90-100	0.056	Ibid.	"very highly toxic"	Y
Brown trout	90-100	0.080	Ibid.	"very highly toxic"	Y
Lake trout	90-100	0.049	Ibid.	"very highly toxic"	Y
Fathead minnow	90-100	0.200	Ibid.	"highly toxic"	Y
Channel catfish	90-100	0.078	Ibid.	"very highly toxic"	Y
Bluegill sunfish	90-100	0.141	Ibid.	"highly toxic"	Y
Yellow Perch	90-100	0.120	Ibid.	"highly toxic"	Y
Harlequin fish	89	0.300	00034713	"highly toxic"	S

The results of the 96-hour acute toxicity studies indicate that captan is "highly to very highly toxic" to fish. The guideline requirements are fulfilled for testing with technical material. **(MRID#s GS0120-042; 00057846; GS0144-0012; 00034713)**

Data from fish early life-stage tests and life-cycle tests with aquatic invertebrates are required for captan since, for example, it is expected to be transported to water from intended use sites, fish acute LC_{50} values are less than 1 mg/L and EECs in water are equal to or greater than 0.01 of fish and invertebrate acute LC_{50} values.

The following fish full life cycle study fulfills the requirement for chronic fish testing.

Fish Life-Cycle Toxicity Findings							
Species	% A.I.	NOEL (ppb)	LOEL (ppb)	MATC (ppb)	MRID No. Author/Year	Endpoints Affected	Fulfills Guideline Requirement
Fathead minnow	88.4	16.5	39.5	>16.5 <39.5 (geom. mean = 25.5)	00057846 Hermanutz (EPA), 1973	survival and growth	Y

The results indicate that fathead minnow growth and survival is affected between 16.5 and 39.5 ppb. The guideline requirement is fulfilled. **(MRID# 00057846)**

Additionally, acute formulated product testing with a typical end-use product is required if the end-use pesticide is applied directly to an aquatic environment, or if the technical LC50 is less than or equal to either the maximum expected environmental concentration or the estimated environmental concentration when the end-use pesticide is used according to the label. For captan, the maximum expected environmental concentrations are expected to exceed the lowest technical LC50 for fish.

(2) Freshwater Invertebrates

The minimum testing required to assess the hazard of a pesticide to freshwater invertebrates is a freshwater aquatic invertebrate toxicity test, preferably using first instar *Daphnia magna* or early instar amphipods, stoneflies, mayflies, or midges.

Freshwater Invertebrate Toxicity Findings					
Species	% A.I.	LC$_{50}$ (ppm)	MRID NO. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Daphnia magna	Tech.	> 7.1 (48-hr.)	00070751 Boudreau, et. al., 1980	"moderately toxic" or less	S
Daphnia magna	90%	8.4 (48-hr.)	GS0120-041 EPA, 1979	"moderately toxic"	Y
Daphnia magna	Tech.	1.3 (26 hr.)	00002875 Frear & Boyd, 1967	"moderately toxic"	S

There is sufficient information to characterize captan as "moderately toxic" to *Daphnia magna*. The guideline requirement is fulfilled. **(MRID#s 00070751; GS0120-041; 00002875)**

Aquatic invertebrate life-cycle testing is required for captan since EECs are expected to exceed 0.01 LC50.

(3) **Estuarine and Marine Animals**

Acute toxicity testing with estuarine and marine organisms is required when an end-use product is intended for direct application to the marine/estuarine environment or is expected to reach this environment in significant concentrations. Captan uses that may result in exposure to the estuarine environment include apples, cherries, pears, turf, and vegetables.

The requirements under this category include a 96-hour LC_{50} for an estuarine fish, a 96-hour LC_{50} for shrimp, and either a 48-hour embryo-larvae study or a 96-hour shell deposition study with oysters, with technical captan. These are currently data gaps.

Testing using formulated products are required, for example, when the EEC $\geq$ LC50. Testing is currently reserved, pending submission and evaluation of technical testing. One supplemental study has been previously reviewed.

Estuarine/Marine Acute Toxicity Findings

Species	% A.I.	LC_{50} (ppm)	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Dungeness crab	50	8 (adjusted for ai)	BA0CAP03 Armstrong, et. al., 1976	"moderately toxic" (based on ai)	S

A guideline requirement would not be fulfilled by this study. **(MRID# BAOCAP03)**

c. **Toxicity to Plants**

(1) **Terrestrial**

Currently, Tier 1 terrestrial plant testing (seedling emergence and vegetative vigor) is required for captan due to phytotoxicity label statements.

(2) **Aquatic**

Currently, aquatic plant testing is required for captan since it has outdoor non-residential terrestrial uses and it may move off-site of application by drift (e.g., it has aerial and air blast applications). The following five species should be tested in Tier 2, due to effects seen in a test with one aquatic species (*Scenedesmus subspicatus*, an algae): *Selenastrum capricornutum*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flosaquae*, and a freshwater diatom. Additionally, any uses involving aerial, air blast, or chemigation application methods will require spray drift studies under guidelines 200-1 and 202-1.

Tier 2 toxicity data on the technical material is listed below:

Nontarget Aquatic Plant Toxicity Findings		
Species	**% A.I.**	**EC_{50}**
Scenedesmus subspicatus	92.7	0.32 mg/l

The results indicate that aquatic concentrations of 0.32 mg/l would produce a 50% inhibition in growth for this test species. The guideline requirements are not fulfilled by this one test.

2. Environmental Fate

a. Environmental Fate Assessment

Although the laboratory database is nearly complete, the lack of complete field data limits EFED's ability to assess with confidence the environmental fate of captan. Data for terrestrial field dissipation, accumulation in confined rotational crops, and fish accumulation are deemed supplemental at this time. All other data requirements needed to support terrestrial food crop uses of captan have been fulfilled. The following assessment is taken from acceptable and supplemental studies.

Parent captan dissipates relatively rapidly via degradative processes. Hydrolysis and aerobic soil metabolism appear to be the major routes of captan dissipation in the environment. In water and soil, the sulfur-nitrogen bond cleaves separating the trichloromethyl and tetrahydrophthalimide (THPI) moieties of the molecule. The trichloromethylthio moiety degrades rapidly to CO_2 and inorganic sulfur and chlorine. THPI degrades to a series of ring-containing products and ultimately to CO_2. The fate of two major degradates, THPI and tetrahydrophthalamic acid (THPAm), cannot be assessed with confidence without additional field data. Photodegradation on soil also occurs, but is secondary to hydrolysis and aerobic soil metabolism. Direct and indirect evidence indicates that residues of THPI and THPAm may be present in soil several months following captan application. THPI (Freundlich K_d values were 0.076-0.76 in five soils) and THPAm (K_d values were 0.18-0.43 in sand, loamy sand, and sandy loam soils and 11.51 in a clay loam) are potentially mobile and may leach in the soil profile. THPAm was stable in an anaerobic soil metabolism study, and may not degrade rapidly at greater soil depths. THPI and THPAm may move with surface runoff.

b. Environmental Fate and Transport

(1) Degradation

Hydrolysis (161-1)

^{14}C-trichloromethyl captan hydrolyzed in sterile aqueous buffer solutions at pH 5, 7, and 9 with half-lives of 18.8 hr, 4.9 hr, and 8.3 min, respectively. Two unidentified degradates, both of which degraded rapidly to $^{14}CO_2$, were detected in the study.

Two previous captan hydrolysis studies were also reviewed. One study (MRID 00096974) partially fulfilled the data requirement by providing information on the hydrolysis of ^{14}C-carbonyl captan and describing the fate of the ring portion of the molecule in sterile aqueous solutions at a pH range of 2-9. Another study (MRID 40208101) provided acceptable information on the hydrolysis of ^{14}C-trichloromethyl captan at pH 9.

Taken together, these three studies fulfill the data requirement. Hydrolysis is an important route of captan dissipation in the environment. No additional data on the hydrolysis of captan are needed at this time. **MRID#s 00096974; 40208101; 41176301)**

Photodegradation

In Water (161-2)

Because hydrolysis, not photolysis, was responsible for captan degradation in an aqueous photolysis study reviewed previously, EFED concluded that the photodegradation in water data requirement for captan would be fulfilled upon submission of acceptable hydrolysis data for pH 5. Acceptable captan hydrolysis data at pH 5 have been submitted. EFED concludes that captan is stable to photolysis in aqueous solution at pH 5. No additional photodegradation in water data for captan are required at this time. **(MRID#s 40208102;41176301)**

Photodegradation on Soil (161-3)

In studies where ^{14}C-captan labeled in the cyclohexene and trichloromethyl positions was applied to moist sandy loam soil and irradiated with natural sunlight, captan degraded with registrant-calculated half-lives of 5 and 15 days, respectively. The registrant-calculated half-lives for dark controls were 10 and 21 days, respectively. After 5 days of irradiation of ^{14}C-cyclohexene captan, 21.3% of the applied radioactivity was present as tetrahydrophthalamide (THPI) and 9.4% was present as cyclohex-4-ene-2-cyano-1-carboxylic acid (THCY). No other single degradate contained >3.2% of the applied radioactivity. For ^{14}C-trichloromethyl captan, the only reported degradate was $^{14}CO_2$ which comprised 41.7% of the applied radioactivity after 16 days of irradiation.

The soil photolysis data submitted are acceptable and fulfill the data requirement. No additional data for captan photodegradation on soil are needed at this time. **(MRID#s 40658009; 40658010)**

Biodegradation

Aerobic Soil Metabolism (162-1)--Carbonyl-labeled captan incubated aerobically in a sandy loam degraded very rapidly with 99% degradation by day 7. Ninety-five percent of the originally applied ^{14}C was present as $^{14}CO_2$ after 322 days. THPI and THPAm were the major degradates identified. The maximum reported THPI concentration occurred at day 7 when 66% of the applied radioactivity was present in this degradate. THPAm reached its maximum reported concentration at day 14 when it comprised 16.5% of the applied radioactivity. Other soil metabolites of captan in quantities exceeding 0.01 ppm were tetrahydrophthalic acid (THPAI), 5,6 dihydroxyhexahydrophthalamide (diol), and THPI-epoxide. In an aerobic soil metabolism study using trichloromethyl (TCM)-labeled active ingredient, captan degraded with a half-life of <1 day in a sandy loam. After 1 day 46% of the applied radioactivity was detected as $^{14}CO_2$, 19.4% was undegraded captan, and 16.7% was unextractable ^{14}C residues. No non-volatile metabolites were detected. In a study submitted in support of captafol, a compound similar to captan in structure and degradation products, THPI degraded with a half-life of approximately 4 days. Degradation products were not identified. **(MRID#s 00070414; 40658007)**

Anaerobic Soil Metabolism (162-2)--After 1 day of aerobic incubation plus 29 days of anaerobic incubation, 4.0% of the radioactivity applied to a sandy loam soil was undegraded captan, 85.6% had evolved as $^{14}CO_2$, 0.8% was uncharacterized, and 16.6% was unextractable. About 80% of the parent captan had degraded during the 1-day aerobic period. In addition to THPI, THPAm, and THPAI, a cyano-acid metabolite of captan, THCY, was identified. Up to 20% of the applied radioactivity was detected as THCY. THCY and THPAm were stable in anaerobic conditions. **(MRID#s 00098881; 40658008)**

(2) Mobility

Leaching, Adsorption/Desorption (163-1)--Soil TLC data indicate that captan is slightly mobile to relatively immobile (R_f 0.21-0.08) in various soils. These data, combined with the hydrolysis, soil metabolism, and terrestrial field data (see below) which indicate that captan is labile, demonstrate that the parent compound is not likely to leach significantly in soil. However, laboratory data submitted for captafol indicate that the degradates THPI and THPAm are mobile.

Freundlich K_d values of 0.076-0.76 were reported for THPI in five soils. For THPAm, K_d values were 0.18-0.43 in sand, loamy sand, and sandy loam soils. In a clay loam, THPAm was relatively immobile with a K_d of 11.51. **(MRID# 40658011)**

Laboratory Volatility (163-2)--Volatility does not appear to be an important route of dissipation for parent captan. Over a 9-day period, approximately 0.003% of ring-labeled captan volatilized from a sand soil treated at a rate of 1 lb a.i./A. Approximately 3.9% of the applied radioactivity volatilized from TCM-labeled captan. None of the labeled volatiles was parent. **(MRID# 40231001)**

(3) **Accumulation**

Accumulation in Confined Rotational Crops (165-1)

EFED concludes that the study submitted and the response to the EFED review provide supplemental information. The study and additional information do not fulfill guidelines because the amount of captan applied to soil was not adequate to assess rotational crop uptake of residues. Additional data are needed to fulfill this guideline.

In lettuce, beets, and wheat planted 34 and 88 days after treatment with radiolabeled captan, residue levels (expressed as captan equivalents) were 0.005-1.822 ppm. Residue levels were lower in mature crops and in crops planted 88 days after treatment. The degradates THPI, THPAm, and THPI diol were detected in all crops harvested 9 days after planting. THPI diol was the only quantifiable captan degradate in plant tissue. Parent captan was not detected in any plant tissue at any time. **(MRID#s 41404001; 42378401)**

Bioaccumulation in Aquatic Organisms (165-4)

Two studies, one each for cyclohexene-labeled and TCM-labeled captan, were submitted. Although neither study is completely acceptable, the data indicate that residues do not accumulate substantially in bluegill sunfish. Accumulated residues were largely eliminated during the depuration period. EFED therefore does not need additional fish accumulation data for captan at this time.

When exposed to a nominal concentration of 5 $\mu g/L$ of ring-labeled ^{14}C-captan for 28 days, bluegill sunfish had ^{14}C bioaccumulation factors of 102X, 126X, and 113X for edible, non-edible, and whole fish tissue, respectively. After a 14-day depuration period, ^{14}C-residues in edible tissue, non-edible tissue, and whole fish declined by 94%, 96%, and 95%, respectively. Degradates in exposure water and fish metabolites were not identified. **(MRID#s 40756601; 40756602; 40225601; 40225602)**

(4) Field Dissipation

Terrestrial

Six studies were submitted, all of which provide supplemental information.

Parent captan degraded with half-lives of 2.5 to 24 days and was relatively immobile to slightly mobile at six sites. The maximum depth at which captan was detected was 6-12 inches. The degradate tetrahydrophthalimide (THPI) was detected at all sites and declined to less than detectable (0.01 ppm) levels between 14 and 184 days after the final captan treatment. THPI was relatively immobile to slightly mobile in the study soils. Its maximum depth of detection was 6-12 inches.

Recurring problems make the studies difficult to interpret. Specifically:

(1) There was no field monitoring for THPAm which was detected in the aerobic soil metabolism study at up to 16.5% of the applied radioactivity. THPAm, which appears to be a degradation product of THPI, is potentially mobile based on Freundlich K_d values (0.18-0.43 in sand, loamy sand, and sandy loam soils; 11.51 in a clay loam) and was stable in an anaerobic soil metabolism study submitted for captafol (chem no. 081701, MRID 00026453).

(2) The validity of soil residue values is questionable in many cases due to: the use of a statistically invalid practice for analyzing some samples; poor stability of analytes in frozen storage; and failure to analyze many samples within the period covered by frozen storage stability data.

Viewed together, the field studies appear to provide relatively consistent estimates of the parent compound's half-life and the rates of formation and decline of THPI. However, due to several common problems, EFED has limited confidence in its ability to thoroughly assess the environmental fate of captan. A more complete assessment of captan dissipation can be made if field data are submitted which address the respectively. After a 14-day depuration period, ^{14}C-residues in edible tissue, non-edible tissue, and whole fish declined by 94%, 96%, and 95%, respectively. Degradates in exposure water and fish metabolites were not identified. **(MRID#s 40756601; 40756602; 40225601; 40225602)**

(4) Field Dissipation

Terrestrial

Six studies were submitted, all of which provide supplemental information.

Parent captan degraded with half-lives of 2.5 to 24 days and was relatively immobile to slightly mobile at six sites. The maximum depth at which captan was detected was 6-12 inches. The degradate tetrahydrophthalimide (THPI) was detected at all sites and declined to less than detectable (0.01 ppm) levels between 14 and 184 days after the final captan treatment. THPI was relatively immobile to slightly mobile in the study soils. Its maximum depth of detection was 6-12 inches.

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Viewed together, the field studies appear to provide relatively consistent estimates of the parent compound's half-life and the rates of formation and decline of THPI. However, due to several common problems, EFED has limited confidence in its ability to thoroughly assess the environmental fate of captan. A more complete assessment of captan dissipation can be made if field data are submitted which address the concerns identified above and in the attached reviews. The data requirement remains unfulfilled at this time. **(MRID#s 40823901; 40893601; 40893602;40893603; 40932201; 40932202)**

c. **Water Resources**

(1) **Surface Water**

Substantial amounts of captan could be available for runoff to surface waters for only a few days to several weeks post-application (aerobic soil metabolism half-life of < 1 to 3 days, terrestrial field dissipation half-lives of 2.5 to 24 days). The relatively low soil/water partitioning of captan (Soil Conservation Service/Agricultural Research Service database K_{oc} of 200; K_d = 3-8) for 4 soils indicates that most captan runoff will be via dissolution in runoff water as opposed to adsorption to eroding soil.

Captan is not susceptible to direct aqueous photolysis or to volatilization from water (estimated Henry's Law constant = 9.6×10^{-10} atm*m^3/mol). However, captan is susceptible to rapid abiotic hydrolysis (half-lives of 12-19 hours at pH 5, 4.9 hours at pH 7, and 8.3 minutes at pH 9). It is also susceptible to fairly rapid microbiological degradation under both aerobic and anaerobic conditions. Consequently, it should not persist in surface waters under most hydrological or chemical conditions. Its relatively low soil/water partitioning indicates that most of the captan in surface waters will be dissolved in the water column as opposed to adsorbed to suspended and bottom sediment. Reported bioconcentration factors for captan of 102X to 113X indicate that its bioaccumulation potential is relatively low.

The major degradates of captan are 4-tetrahydrophthalimide (THPI) and 4-tetrahydrophthalimic acid (THPAM). Both exhibit low soil/water partitioning (K_d values < 1) which indicates that most of their runoff will be via dissolution in runoff water as opposed to adsorption to eroding soil. Both degrade at rates comparable to those of captan (relatively rapidly) under aerobic conditions, but THPZAM is reported to be much more persistent under anaerobic conditions.

The State of Illinois (Moyer and Cross 1990) sampled 30 surface water sites for pesticides at various times from October 1985 through October 1988. Substantial use in Illinois was a criterion for pesticides being included in the analyses. Total (dissolved and adsorbed to suspended sediment) captan was not detected above a detection limit of 0.05 ug/L in any of 580 samples collected from the 30 sites sampled.

EFED has used computer modeling to generate Tier 2 (single site over multiple years) EECs for captan in a 1 ha surface area, 2 m deep pond draining 10 ha almond, apple, peach, prune, cherry and blueberry fields. The EECs were generated for use in performing aquatic risk assessments. One site was modeled for each crop. Each site represents reasonable high exposure and was simulated over 36 years. The 1 in 10 years EECs, assumed application rates, and assumed number of applications for each site are listed further in this document.

(2) Ground Water

The environmental fate characteristics of parent captan indicate that it probably will not be a major ground-water contaminant. However, limited information suggests that two of its degradates -- THPI and THPAm -- may be sufficiently mobile and persistent to leach to ground water. Information indicating stability under anaerobic conditions is somewhat more definitive for THPAm than for THPI; both degradates are highly mobile in many soils. As stated above, there is both direct and indirect evidence indicating that residues of THPI and THPAm may be present in soil several months following captan application.

Captan has been detected in ground water in four wells in California with concentrations ranging from 0.1 to 0.5 ppb. The wells fed public supply water systems that were considered "vulnerable" and the detections were probably from nonpoint sources. The wells were resampled and no residues were found (CA Department of Pesticide Monitoring, 5/11/95). Monitoring in approximately 700 wells in seven other states showed no evidence of captan contamination. No monitoring information is available for THPI or THPAm in the Agency's Pesticides in Ground Water Database, 1992.

The degradate THPI has the potential to exceed the levels of concern for ground water but sufficient information is not available at present to make a definitive assessment. Results from the previously recommended field dissipation study would be very useful in determining the leaching potential of this degradate and of parent captan.

3. Exposure and Risk Characterization

a. Ecological Exposure and Risk Characterization

Explanation of the Risk Quotient (RQ) and the Level of Concern (LOC): The Levels of Concern are criteria used to indicate potential risk to nontarget organisms. The criteria indicate that a chemical, when used as directed, has the potential to cause undesirable effects on nontarget organisms. There are two general categories of LOC (acute and chronic) for each of the four nontarget faunal groups and one category (acute) for each of two nontarget floral groups. In order to determine if an LOC has been exceeded, a risk quotient is derived and compared to the LOC's. A risk quotient is calculated by dividing an appropriate exposure estimate, e.g. the estimated environmental concentration, (EEC) by an appropriate toxicity test effect level, e.g. the LC_{50}. The acute effect levels typically are:

-EC_{25} (terrestrial plants),
-EC_{50} (aquatic plants and invertebrates),
-LC_{50} (fish and birds), and
-LD_{50} (birds and mammals)

The chronic test results are the:

-NOEL (sometimes referred to as the NOEC) for avian and mammal reproduction studies; and either the NOEL for chronic aquatic studies, or the Maximum Allowable Toxicant Concentration (MATC), which is the geometric mean of the NOEL and the LOEL (sometimes referred to as the LOEC), for chronic aquatic studies.

When the risk quotient exceeds the LOC for a particular category, risk to that particular category is presumed to exist. Risk presumptions are presented along with the corresponding LOC's.

Levels of Concern (LOC) and associated Risk Presumption

Mammals, Birds

IF THE	LOC	PRESUMPTION
acute RQ>	0.5	High acute risk
acute RQ>	0.2	Acute risk that may be mitigated through restricted use
acute RQ>	0.1	Endangered species may be affected acutely.
chronic RQ>	1	Chronic risk, endangered species may be affected chronically,

Fish, Aquatic invertebrates

IF THE	LOC	PRESUMPTION
acute RQ>	0.5	High acute risk
acute RQ>	0.1	Acute risk that may be mitigated

		through restricted use
acute RQ>	0.05	Endangered species may be affected acutely
chronic RQ>	1	Chronic risk, endangered species may be affected chronically

Plants

IF THE	LOC	PRESUMPTION
RQ>	1	High risk
RQ>	1	Endangered plants may be affected

Currently, no separate criteria for restricted use or chronic effects for plants exist.

(1) **Exposure and Risk to Nontarget Terrestrial Animals**

(a) Birds

Residues found on dietary food items following captan application may be compared to LC_{50} values to predict hazard. The maximum concentrations of residues of captan which may be expected to occur on selected avian or mammalian dietary food items following both a single and multiple foliar application rates are provided in the tables below. Residues per lb ai applied for the four food types are developed from Hoerger and Kenaga (1972) and Kenaga (1973), with modifications suggested by Fletcher, et. al. (1994); the "broadleaf plants" category includes forage and is considered applicable to small insects while the "fruits" category includes seeds and is considered applicable to large insects.

For avian acute risk, there are no definitive risk quotients since definitive LC50s are not available (i.e. no mortality reported at the highest test levels). Similarly for avian chronic risk, no effects were reported at the highest test level. However, EECs sometimes exceed these levels. Avian dietary and reproduction testing at higher exposures would be needed to provide definitive risk quotients.

Avian EECs -- Single Application*			
Use Site	**Applic. rate**	**Food item**	**EEC (ppm)**
Turf**	43.56**	short grass	10,454
		long grass	4,792
		broadleaf plants	5,881
		fruits	653
Almonds	5.25***	short grass	1,260
		long grass	578
		broadleaf plants	709
		fruits	79
Apples	4.5	short grass	1,080
		long grass	495
		broadleaf plants	608
		fruits	68
Peaches Nectarines	4	short grass	960
		long grass	440
		broadleaf plants	540
		fruits	60
Pears Plums/fresh prunes Strawberries	3	short grass	720
		long grass	330
		broadleaf plants	405
		fruits	45
Apricots Blueberries	2.5	short grass	600
		long grass	275
		broadleaf plants	338
		fruits	38
Cherries Grapes	2	short grass	480
		long grass	220
		broadleaf plants	270
		fruits	30

*foliar sites and rates from HED Table (except as noted)
**turf maximum rate from 9/94 LUIS report
***from RD (1/13/95 message)

As can be seen in the above table, even a single application to turf at the high rate shown can result in residues that exceed those in available LC50 tests. To evaluate the risk of such residues, LC50 tests with the two preferred test species, mallard and northern bobwhite, should be conducted at test levels above 5000 ppm to produce definitive LC50s. For the other sites shown, maximum residues from a single application are below the no-mortality levels for all species tested and are thus unlikely to result in avian mortality from dietary exposure.

Similarly, avian reproduction testing was conducted to 1000 ppm, with no effects reported. Risk assessment at higher exposures (e.g., even a single application for apples, almonds, or turf) would require testing at higher concentrations.

For multiple applications, a fate model is used to estimate residues based on accumulation due to repeat applications at a given interval and degradation due to estimated foliar dissipation. Since actual foliar half-life data are not available, the dissipation "half-life" was estimated by EFED, based partly on dislodgeable residue information available to the Agency. Actual dissipation is not expected to be linear, but instead related mainly to rainfall.

Avian EECs -- Multiple Applications*					
Use Site	Applic. rate	No. of applics.	Applic. interval (days)	Food item	EEC(ppm) max.
Almonds	5.25**	5**	5***	short grass	3,368
				long grass	1,545
				broadleaf plants	1,895
				fruits	211
Apples	4.5	7	7	short grass	2,532
				long grass	1,161
				broadleaf plants	1,425
				fruits	159
Peaches Nectarines	4	8	3	short grass	3,921
				long grass	1,797
				broadleaf plants	2,205
				fruits	245
Pears Plums/fresh prunes Strawberries	3	9	7	short grass	1,714
				long grass	786
				broadleaf plants	964
				fruits	107
Apricots Blueberries	2.5	14	7	short grass	1,439
				long grass	660
				broadleaf plants	811
				fruits	91
Cherries Grapes	2	7	3	short grass	1,865
				long grass	855
				broadleaf plants	1,049

				fruits	117

*foliar sites and rates from HED Table (except as noted); number of applications (based on maximum seasonal rates) and application intervals are for underlined crops. Foliar "half-life" used is 9 days as estimated by EFED scientists 3/1/95, see discussion above).
**from RD (1/13/95 message)
***from RD (3/6/95)

For the sites evaluated, estimated residues resulting from multiple applications at the maximum rates and minimum intervals are below the no-mortality level in all but one avian LC50 test (this one exception had a highest test level of 2400 ppm, with no mortality). It thus appears unlikely that these dietary residues would result in avian mortality. Turf is not included since the 9/94 LUIS report did not indicate whether turf has repeat applications or if so, how many. Since even single turf applications at the maximum rate exceed maximum test levels, as seen earlier, any repeat applications would obviously exceed it further (and thus, the additional acute testing noted above would be needed for risk assessment).

As noted earlier, to assess reproductive risk at exposures over 1000 ppm would require testing at higher levels. With multiple applications, all sites have estimated maximum residues on one or more food items that exceed this level.

(b) Mammals

Small mammal exposure is addressed using acute oral LD_{50} values converted to estimate a LC_{50} value for dietary exposure. The estimated LC_{50} is derived using the following formula:

$$LC_{50} = \frac{LD_{50} \text{ x body weight (g)}}{\text{food cons. per day (g)}}$$

Small Mammal Food Consumption in PPMs (Based on an LD_{50} = mg/kg)				
Small Mammal	**Body Weight in Grams**	**% of Weight Eaten Per Day**	**Food Consumed Per Day in Grams**	**Estimated LC_{50} Per Day in PPMs**
Meadow vole	46 gms	61 %	28.1 gms	2226 ppm
Adult field mouse	13 gms	16 %	2.1 gms	8419 ppm
Least shrew	5 gms	110 %	5.5 gms	1236 ppm

The above table is based on information contained in Principles of Mammalogy by D. E. Davis and F. Golley, published by Reinhold Corporation, 1963.

The estimated LC_{50} is then compared to the residues listed above to calculate a risk quotient (EEC/LC_{50}). The "estimated LC50" in these calculations can be considered as the concentration of toxicant in a day's diet, lethal to 50% of a test population. The table below indicates the risk quotients for each of the indicated application rates.

Mammal Risk Quotients* -- Single Application

Use Site	Applic. rate	Small mammal	Risk Quotient
Turf**	43.56**	meadow vole	4.7
		field mouse	0.07
		least shrew	4.8
Almonds	5.25***	meadow vole	0.56
		field mouse	0.009
		least shrew	0.57
Apples	4.5	meadow vole	0.49
		field mouse	0.008
		least shrew	0.49
Peaches Nectarines	4	meadow vole	0.43
		field mouse	0.007
		least shrew	0.44
Pears Plums/fresh prunes Strawberries	3	meadow vole	0.32
		field mouse	0.005
		least shrew	0.33
Apricots Blueberries	2.5	meadow vole	0.27
		field mouse	0.004
		least shrew	0.27
Cherries Grapes	2	meadow vole	0.22
		field mouse	0.004
		least shrew	0.22

*foliar sites and rates from HED Table (except as noted)
The current standardized models are as follows:
-meadow vole consuming short grass
-adult field mouse consuming seeds
-least shrew consuming forage and small insects
**turf maximum rate from 9/94 LUIS report
***from RD (1/13/95 message)

For single applications, the high acute LOC is exceeded for turf and almonds. The restricted use and endangered species acute LOCs are exceeded for all sites modelled. Chronic LOCs would therefore be exceeded for all the rates evaluated, since the lowest chronic toxicity values are considerably lower than acute values.

Mammal Risk Quotients -- Multiple Applications*

Use Site	Applic. rate	No. of applics.	Applic. interval (days)	Small mammal	Risk Quotient
Almonds	5.25**	5**	5***	meadow vole	1.5
				field mouse	0.025
				least shrew	1.5
Apples	4.5	7	7	meadow vole	1.1
				field mouse	0.019
				least shrew	1.2
Peaches Nectarines	4	8	3	meadow vole	1.8
				field mouse	0.029
				least shrew	1.8
Pears Plums/fresh prunes Strawberries	3	9	7	meadow vole	0.8
				field mouse	0.013
				least shrew	0.8
Apricots Blueberries	2.5	14	7	meadow vole	0.6
				field mouse	0.011
				least shrew	0.7
Cherries Grapes	2	7	3	meadow vole	0.8

				field mouse	0.014
				least shrew	0.8

*foliar sites and rates from HED Table (except as noted); number of applications (based on maximum seasonal rates) and application intervals are for underlined crops. Estimated foliar "half-life" used is 9 days (P. Mastradone/A. Jones, pers. comm., see discussion above). The current standardized models are as follows:

-meadow vole consuming short grass
-adult field mouse consuming seeds
-least shrew consuming forage and small insects

**from RD (1/13/95 message)
***from RD (3/6/95)

With repeat applications, the high acute risk, restricted use, and endangered species acute LOCs are exceeded for all sites modeled. Chronic LOCs would therefore be exceeded for all the rates evaluated, since the lowest chronic toxicity values are considerably lower than acute values.

(2) **Exposure and Risk to Nontarget Aquatic Animals**

Expected Aquatic Concentrations: Captan displays very high toxicity to most fish species tested. A refined EEC is included here for those use sites that EFED was able to model. This EEC is determined using environmental fate and transport computer models. The Pesticide Root Zone Model (PRZM2) was used to simulate pesticides in field runoff and the Exposure Analysis Modeling System (EXAMS II) to simulate pesticide fate and transport in an aquatic environment (one acre body of water).

For turf, EFED calculated generic EEC levels, since it was not possible to produce a refined EEC for this site. These generic levels were based on runoff from a 10 hectare field to a 1 hectare x 2 meter deep water body, and take into account degradation in the field prior to a rain event.

ESTIMATED ENVIRONMENTAL CONCENTRATIONS (EECs) FOR CAPTAN*

Crop	Application Method	Application Rate in lbs a.i./A (No. of applics.)	Initial EEC (ppb)	4-day EEC (ppb)	21-day EEC (ppb)	60-day EEC (ppb)	90-day EEC (ppb)
Turf	foliar	43.56 (1)	623.0	163.1	31.1	11.7**	———
Almonds	spray blast	5.25 (6)	216.8	56.6	14.5	10.6	8.2

Apples	spray blast	4.5 (7)	102.0	28.4	6.2	5.0	3.6
Peaches	spray blast	4.0 (8)	546.8	111.2	24.9	17.5	13.4
Prunes	spray blast	3.0 (9)	118.2	30.8	7.9	5.7	4.6
Cherries	spray blast	2.0 (7)	28.0	5.5	2.7	2.3	1.7
Blueberries	spray blast	2.5 (14)	161.0	33.4	8.0	6.5	4.7

*EECs for all sites, except turf, from EFED review using PRZM2 and EXAMS II. Turf EECs from GENEEC model developed by EFED.

**average 56-day EEC

(a) Freshwater Fish

Risk Quotients (RQ) for Freshwater Fish (LC50 for brook trout, most sensitive species, = 34 ppb; acute RQ = initial EEC/LC50; chronic RQ = geometric mean of fish full life-cycle NOEL and LOEL/ 90-day EEC*)		
Crop/application rate (lb ai/A)	Acute RQ	Chronic RQ
Turf (43.56)	18.3	0.46
Almonds (5.25)	6.4	0.32
Apples (4.5)	3.0	0.14
Peaches (4.0)	16.1	0.53
Prunes (3.0)	3.5	0.18
Cherries (2.0)	0.8	0.07
Blueberries (2.5)	4.7	0.18

*56-day EEC for turf (GENEEC model)

Foliar turf applications and spray blast applications to fruit and nut crops are expected to exceed high acute risk, restricted use, and endangered species LOCs for fish. Chronic risk LOCs are not expected to be exceeded.

(b) Freshwater Invertebrates

Risk Quotients (RQ) for Freshwater Invertebrates (lowest LC50 for *D. magna* = 1300 ppb; acute RQ = initial EEC/LC50; chronic data not available)		
Crop/application rate (lb ai/A)	Acute RQ	Chronic RQ
Turf (43.56)	0.45	NA
Almonds (5.25)	0.17	NA
Apples (4.5)	0.08	NA
Peaches (4.0)	0.42	NA
Prunes (3.0)	0.09	NA
Cherries (2.0)	0.02	NA
Blueberries (2.5)	0.12	NA

The aquatic invertebrate restricted use LOC is exceeded for the following modelled sites: single foliar turf applications and multiple spray blast applications to almonds, peaches, and blueberries. The endangered species acute LOC is exceeded for all modeled sites, except cherries. Chronic effects to aquatic invertebrates cannot be evaluated until submission of chronic toxicity data.

(3) Exposure and Risk to Nontarget Plants

A full plant exposure and risk assessment will await submission of required terrestrial and aquatic plant testing. However, the one available aquatic plant EC50 (for *S. subspicatus*, an alga) is 320 ppb. Comparing this value to the maximum initial aquatic EECs shown earlier indicates that the aquatic plant high risk and endangered species LOCs are exceeded for turf and peaches.

(4) Seed Treatments

Foliar treatments of captan would generally be expected to pose a greater risk to aquatic life because of repeat applications, runoff,and drift, for example. Also, foliar treatments are not soil-incorporated whereas seed treatments would be to varying degrees. EFED does not currently have the capacity to estimate runoff resulting from seed treatments.

In general, seed treatments have the capacity to pose risks to birds since seeds could be attractive as a food item. In the case of captan, however, the chemical is generally in the "practically nontoxic" category for birds, implying low risk. The highest exposure, and thus risk, would appear to be with grass seed. It has, along with several others, the highest labeled rate (9 oz. ai/100 lbs of seed). It is also broadcast, as opposed to being placed in furrows. It is also only lightly covered, to allow for germination. This rate translates into approximately 5625 ppm (9/16)/100 on the seeds. If a bird's diet were composed entirely of treated seeds, the residues would be slightly higher than the highest test level in most dietary studies, where no mortality was seen. Thus, while a major risk seems unlikely, testing at higher levels would be needed to complete a full risk assessment.

(5) Risk Characterization of Captan Degradates/Metabolites

EFED has identified a number of degradates/metabolites for captan. These include THPI and THPAm, which may be present in soil several months following captan application and may move with surface runoff. Current toxicity data are mostly with technical captan. To the degree that captan degrades/metabolizes during studies, the toxicity of these chemicals would be partially reflected by the study results. Additional testing specifically on degradates/metabolites has been recommended above.

(6) Endangered Species

The Endangered Species Protection Program is expected to become final in 1995. Limitations in the use of captan may be required to protect endangered and threatened species, but these limitations have not been defined and may be formulation specific. EPA anticipates that a consultation with the Fish and Wildlife Service may be conducted in accordance with the species-based priority approach described in the Program. After completion of consultation, registrants will be informed if any required label modifications are necessary. Such modifications would most likely consist of the generic label statement referring pesticide users to use limitations contained in county Bulletins.

b. **Water Resources Risk Implication for Human Health**

(1) **Surface Water**

Captan is not currently regulated under the Safe Drinking Water Act (SDWA). Therefore no MCL has been established for it and water supply systems are not required to sample and analyze for it. Drinking water health advisory levels (HALs) have not been established for it either. Furthermore, the rapid degradation of captan in surface water should limit its annual average concentration (which would be compared to the MCL if captan had one). Therefore, EFED is not currently recommending that captan be monitored for in surface water source supply systems.

Finally, EFED does not currently believe that surface water labeling is needed for captan. However, if a decision is made to generate a labeling surface water advisory for captan, a recommended statement is contained in the memorandum accompanying this report.

(2) **Ground Water**

Parent captan is a B2 carcinogen for which, as mentioned above, no MCL or health advisory level has been established. THPI is not a carcinogen but it is compared to and regulated under the reference dose for animals. THPAm is not considered to be toxic by the Agency's Health Effects Division. Recommendations may be considered once results of the above noted field dissipation study are available.

Literature Citations

Fletcher, J., J. Nellessen, and T. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residues on plants. Environmental Toxicology and Chemistry 13(9): 1383-1391.

Hoerger, F. and E. Kenaga. 1972. Pesticide residues on plants: correlation of representative data as a basis for estimation of their magnitude in the environment. Pp. 9-28 in Coulston, F. and F. Koste (eds.), Environmental quality and safety, vol. 1, Academic Press, New York.

Kenaga, E. 1973. Factors to be considered in the evaluation of the toxicity of pesticides to birds in their environment. Pp. 166-181 in Coulston, F. and F. Koste (eds.), Environmental quality and safety, vol. 2, Academic Press, New York.

The status of the environmental fate data requirements for captan for terrestrial food crop, terrestrial feed crop, indoor non-food, and residential outdoor uses is summarized below:

Environmental Fate Data Requirements	Status	MRID Number
Degradation		
161-1 Hydrolysis	Fulfilled (PJM - 08/30/85; LL - 08/01/88; AWJ - 08/26/93)	00096974 40208101 41176301
161-2 Photo. - water	Fulfilled (LL - 08/01/88; AWJ - 08/26/93)	40208102 41176301
161-3 Photo. - soil	Fulfilled (LL - 08/08/88) AWJ - 08/26/93)	40658009 40658010
161-4 Photo. - air	Not Required[1]	
Metabolism		
162-1 Aerobic soil	Fulfilled (PJM - (LL - 08/08/88)	00070414 40658007
162-2 Anaerobic soil	Fulfilled (LL - 08/08/88)	00098881 40658008
162-3 Anaerobic aqua.	Not Required[2]	
162-4 Aerobic aquatic	Not Required[2]	
Mobility		
163-1 Leaching, Ads./ Desorption	Fulfilled[3] (LL - 08/08/88 AWJ - 08/26/93)	40658011
163-2 Volatility-lab	Fulfilled (LL - 07/08/88)	40231001
163-3 Volatility-field	Not Required[1] (LL - 07/08/88)	
Dissipation		
164-1 Soil	Not fulfilled (AWJ - 08/26/93)	40823901, 40893601 40893602, 40893603

164-2 Aquatic	Not required[4]	40932201, 40932202
164-3 Forest	Not Required[2]	
164-5 Soil, long-term	Not required	

Accumulation

165-1 Conf rotat. crop	Not fulfilled[5] (AWJ - 04/14/92, 08/26/93)	41404001, 42378401
165-2 Field rotat. crop	Reserved[6]	
165-3 Irrigated crop	Not required[4]	
165-4 Fish	Not fulfilled[7] (AWJ - 08/26/93)	40756601, 40756602 40225601, 40225602

Spray Drift

201-1 Drop size spec.	Not submitted[8]
202-1 Drift field eval.	Not submitted[8]

Footnotes:

[1] Because volatility does not appear to be an important route of dissipation, this study is not needed at this time.

[2] These data are needed to support forestry use. They are not required if this use has been dropped.

[3] EFGWB's review of 08/08/88 indicated that soil TLC data for parent captan were acceptable and that data were needed to assess the mobility of captan degradates. Freundlich K_d values for THPI and THPAm were submitted for captafol (chem no. 081701; MRID unknown; EAB review of 07/02/85). No additional mobility data are needed for captan or its degradates at this time.

[4] This study is not required at the present time because all aquatic uses for captan have been dropped (Captan Status Report, SRRD, 05/28/93)

[5] Supplemental data for the accumulation in confined rotational crops data requirement were submitted to EFGWB. Additional data are needed to fulfill this guideline. These

data should be submitted to HED which now reviews these studies.

[6] This study is reserved pending the results of acceptable accumulation in confined rotational crops data.

[7] The data submitted were not completely acceptable. However, supplemental data indicate that residues did not accumulate significantly in bluegill sunfish. EFGWB does not need additional fish accumulation data at this time.

[8] These data may be requested by EFED/EEB and/or HED to support aerial and/or air blast application methods.

rotational crops data.

[7] The data submitted were not completely acceptable. However, supplemental data indicate that residues did not accumulate significantly in bluegill sunfish. EFGWB does not need additional fish accumulation data at this time.

[8] These data may be requested by EFED/EEB and/or HED to support aerial and/or air blast application methods.

Date:
Case No: 0120
Chemical No: 081301

PHASE V
DATA REQUIREMENTS FOR CAPTAN
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
6 Basic Studies in Bold					
71-1(a) Acute Avian Oral, Quail/Duck	TGAI	ABCHIKLM	yes	MRID GS0120-045 GS9999-001 00020560 00151236	no
71-1(b) Acute Avian Oral, Quail/Duck	(TEP)				
71-2(a) Acute Avian Diet, Quail	TGAI	ABCHIKLM	yes	MRID 00022923 00104686	yes[3]
71-2(b) Acute Avian Diet, Duck	TGAI	ABCHIKLM	yes	MRID 00022923	yes[3]
71-3 Wild Mammal Toxicity					
71-4(a) Avian Reproduction Quail	TGAI	ABCK	yes	MRID 00098295 00104083	yes[4]
71-4(b) Avian Reproduction Duck	TGAI	ABCK	yes	MRID 00098296	yes[4]
71-5(a) Simulated Terrestrial Field Study					
71-5(b) Actual Terrestrial Field Study					
72-1(a) Acute Fish Toxicity Bluegill	TGAI	ABCHIKLM	yes	MRID GS0120-042 GS0144-012 00034713 00057846	no
72-1(b) Acute Fish Toxicity Bluegill	(TEP)	ABCK	no		yes[5]
72-1(c) Acute Fish Toxicity Rainbow Trout	TGAI	ABCHIKLM	yes	MRID 00057846 GS0144-012	no
72-1(d) Acute Fish Toxicity Rainbow Trout	(TEP)	ABCK	no		yes[5]
72-2(a) Acute Aquatic Invertebrate Toxicity	TGAI	ABCHIKLM	yes	MRID 00070751 GS0120-041 0002875	no

* In Bibliographic Citation column indicates study may be upgradeable

Date:
Case No: 0120
Chemical No: 081301

PHASE V
DATA REQUIREMENTS FOR CAPTAN
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA 3(c)(2)(B)?
72-2(b) Acute Aquatic Invertebrate Toxicity	(TEP)	ABCK	no		no
72-3(a) Acute Estu/Mari Tox Fish	TGAI	ABCK	no		yes[6]
72-3(b) Acute Estu/Mari Tox Mollusk	TGAI	ABCK	no		yes[6]
72-3(c) Acute Estu.Mari Tox Shrimp	TGAI	ABCK	no		yes[6]
72-3(d) Acute Estu/Mari Tox Fish	(TEP)	ABCK	no		reserved[7]
72-3(e) Acute Estu/Mari Tox Mollusk	(TEP)	ABCK	no		reserved[7]
72-3(f) Acute Estu/Mari Tox Shrimp	(TEP)	ABCK	no		reserved[7]
72-4(a) Early Life-Stage Fish	TGAI	ABCK	yes	MRID 00057846	no/reserved[9]
72-4(b) Life-Cycle Aquatic Invertebrate	TGAI	ABCK	no		yes/reserved[9]
72-5 Life-Cycle Fish	TGAI	ABCK	yes	MRID 00057846	no
72-6 Aquatic Org. Accumulation					
72-7(a) Simulated Aquatic Field Study					
72-7(b) Actual Aquatic Field Study					
122-1(a) Seed Germ./Seedling Emerg.	TGAI	ABCK	no		yes[10]
122-1(b) Vegetative Vigor	TGAI	ABCK	no		yes[10]
122-2 Aquatic Plant Growth	TGAI	ABCK	no		no
123-1(a) Seed Germ./Seedling Emerg.	TGAI	ABCK	no		reserved[11]
123-1(b) Vegetative Vigor	TGAI	ABCK	no		reserved[11]
123-2 Aquatic Plant Growth	TGAI	ABCK	partially	Acc. No. 252586	yes[12]
124-1 Terrestrial Field Study					

* In Bibliographic Citation column indicates study may be upgradeable

Date:
Case No: 0120
Chemical No: 081301

PHASE V
DATA REQUIREMENTS FOR CAPTAN
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
124-2 Aquatic Field Study					
141-1 Honey Bee Acute Contact	TGAI	ABCK	yes	MRID 00080871 05001991	no
141-2 Honey Bee Residue on Foliage					
141-5 Field Test for Pollinators					

* In Bibliographic Citation column indicates study may be upgradeable

1. Composition: TGAI = Technical grade of the active ingredient; PAIRA = Pure active ingredient, radiolabeled; TEP = Typical end-use product

2. Use Patterns: A = Terrestrial Food Crop; B = Terrestrial Feed Crop; C = Terrestrial Non-Food Crop; D = Aquatic Food Crop; E = Aquatic Non-Food Outdoor; F = Aquatic Non-Food Industrial; G = Aquatic Non-Food Residential; H = Greenhouse Food Crop; I = Greenhouse Non-Food Crop; J = Forestry; K = Outdoor Residential; L = Indoor Food; M = Indoor Non-Food; N = Indoor Medical; O = Indoor Residential; Z = Use Group for Site 00000

3. Additional testing is needed at > 5000 ppm to support uses with EECs exceeding 5000 ppm (e.g., foliar turf and certain high-rate seed treatments). A definitive LC50 will enable calculation of definitive risk quotients.

4. Available avian reproduction studies support uses for exposures up to 1000 ppm. Testing at higher concentrations is needed to assess risk of higher concentrations.

5. TEP testing is needed for those use patterns where EEC ≥ LC50.

6. Marine/estuarine testing with TGAI is needed to assess risk for those use sites, including apples, cherries, pears, vegetables, and turf that could involve exposure of marine/estuarine organisms.

7. Testing with TEP(s) is needed to evaluate those use patterns with marine/estuarine exposure where the EEC ≥ LC50 with TGAI. Testing is reserved pending submission and review of marine/estuarine testing on TGAI.

8. The fish life-cycle study cited has been previously determined to fulfill the requirement for a freshwater fish early life-stage study. This study is reserved for a marine/estuarine fish species, pending submission and review of acute marine/estuarine testing with TGAI.

9. Although aquatic invertebrates are less sensitive than fish in acute tests with captan, the Agency is now requiring chronic testing for both fish and invertebrates whenever chronic testing is needed (as per approved changes to 40 CFR part 158). For aquatic invertebrates, testing is needed since EECs are ≥ 0.01 LC50, for example. Testing is reserved for marine/estuarine species pending submission of acute testing with TGAI.

10. Tier 1 terrestrial plant testing (seedling emergence and vegetative vigor) is required for captan due to phytotoxicity label statements.

11. Tier 2 terrestrial plant testing is reserved, pending submission and review of Tier 1 testing.

12. Aquatic plant testing is required for captan since it has outdoor non-residential terrestrial uses and it may move off-site of application by drift (e.g., it has aerial and air blast applications). The following five species are required, in Tier 2, due to effects seen in a test with one aquatic species (*Scenedesmus subspicatus*, an algae): *Selenastrum capricornutum*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flosaquae*, and a freshwater diatom. Additionally, any uses involving aerial, air blast, or chemigation application methods will require spray drift studies under guidelines 200-1 and 202-1.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

SEP - 7 1993

Case No: 0120
Chemical No: 081301
Barcode Nos: D156527, 169249, ~~169250~~, 169253, 169257, 169277, 174093, 180650, 191743, 193536
EFGWB Nos: 90-0032, 90-0478, 91-0039, 92-0020, 92-0060, 92-0061, 92-0062, 92-0063, 92-0500, 92-1165; 93-0766, 93-0908

MEMORANDUM

SUBJECT: Captan - List A RED Candidate

Henry M. Jacoby 9/7/93

FROM: Henry M. Jacoby, Chief
Environmental Fate and Ground Water Branch
Environmental Fate and Effects Division (H7507C)

TO: Lois A. Rossi, Chief
Reregistration Branch
Special Review and Reregistration Branch (H7508W)

AND: Everett Byington, Chief
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (H7507C)

Attached is the environmental fate and ground water package for the captan List A RED. The package contains an environmental fate assessment and reviews of environmental fate studies received by EFGWB. Except for terrestrial field dissipation (164-1), all environmental fate guidelines needed to support terrestrial food and feed crop, indoor non-food, and residential outdoor uses are fulfilled at this time. If SRRD feels that a more thorough environmental fate assessment is needed to make its decision on the reregistration of captan, EFGWB recommends that at least one field dissipation study be conducted. This study may confirm laboratory study results and should address clearly the formation and dissipation of THPI and THPAm, the major degradates, in actual use conditions. Other issues identified in the attached DERs should also be addressed. The information gained from this study will enable EFGWB to determine the persistence and potential mobility of THPI and THPAm following multiple applications of captan.

Because of the lack of key data, a comprehensive environmental fate assessment for captan cannot be completed at this time. Acceptable laboratory and supplemental field data indicate that parent captan degrades relatively rapidly via hydrolysis and aerobic soil metabolism. The sulfur-nitrogen bond of the captan molecule appears to cleave hydrolytically leaving tetrahydrophthalimide (THPI) as the principal degradate. The trichloromethylthio moiety degrades rapidly to CO_2 and its inorganic constituents.

Laboratory and field data appear to describe adequately the fate of parent captan and provide relatively consistent estimates of the rates of formation and decline of THPI. However, since the parent molecule is labile, a more thorough understanding the fate of the major degradation products (which appear to be mobile) is essential before the overall environmental fate profile can be completed. Recurring problems in the field studies, including the lack of adequate monitoring of degradates, limit EFGWB's confidence in the environmental fate assessment for captan at this time. Additional field data are needed which address the fate of degradates more completely.

Additional data are needed to fulfill the accumulation in confined rotational crops data requirement (165-1). Responsibility for reviewing accumulation in rotational crops studies has been transferred from EFGWB to HED. The additional data supporting this guideline should be submitted to HED. Also, the LUIS report indicates that captan has forestry uses. Data to support the forestry use have not been submitted.

Spray drift data (droplet size spectrum [201-1] and drift field evaluation [201-1]) may be requested by EFED/EEB and/or HED to support aerial and/or air blast application methods.

Chemical Code: 081301

Date Out: - 7 SEP 1993

ENVIRONMENTAL FATE AND GROUND WATER BRANCH

Review Action

To: Linda Propst, PM 73
Special Review and Reregistration Division (H7508W)

From: Paul J. Mastradone, Ph.D., Chief, Review Section 1
Environmental Fate & Ground Water Branch/EFED (H7507C)

Paul J. Mastradone

Thru: Henry M. Jacoby, Chief
Environmental Fate & Ground Water Branch/EFED (H7507C)

Henry M. Jacoby 9/7/93

Attached, please find the EFGWB review of...

DP Barcode:	D156527, 169249, 169250, 169253, 169257, 169277, 174093, 180650, 191743, 193536		
Common Name:	Captan	**Trade name:**	Captan
Company Name:	Zeneca, Inc.		
ID #:	081301		
Purpose:	Review environmental fate data for List A RED.		

Type Product:	Action Code:	EFGWB #(s):	Review Time:
Fungicide	606	90-0032, 0478; 91-0039; 92-0020, 0060, 0061, 0062, 0063, 0500, 1165; 93-0766, 0908	30 days

STATUS OF STUDIES IN THIS PACKAGE: **STATUS OF DATA REQUIREMENTS:**

Guideline #	MRID	Status[1]		Status[2]
161-1	41176301	A		S
161-2	41176301	A		S
161-3	Addendum	A		S
164-1	40823901 40893601 40893602 40893603 40932201 40932202	C C C C C C		P P P P P P
165-1	42378401	C		N
165-4	40225601 40225602 40756601 40756602	I I C I		P

[1]Study Status Codes: A=Acceptable U=Upgradeable C=Ancillary I=Invalid.
[2]Data Requirement Status Codes: S=Satisfied P=Partially satisfied N=Not satisfied R=Reserved.

1.0 CHEMICAL:

Common Name: Captan

Chemical Name: N-trichloromethylthio-4-cyclohexene-1,2-dicarboximide

Chemical Structure:

Chemical/physical properties:

empirical formula:	$C_9H_8Cl_3NO_2S$
molecular weight:	300.6
melting point:	175°C - analytical grade
solubility:	<3.3 mg/L in water at room temperature
vapor pressure:	$<10^{-6}$ mm Hg at 25°C

2.0 TEST MATERIAL: See individual DERs.

3.0 STUDY/ACTION TYPE:

Review data submitted for a Reregistration Eligibility Document (RED) and prepare an environmental fate assessment for captan.

4.0 STUDY IDENTIFICATION: See attached DERs.

5.0 REVIEWED BY:

Arnet W. Jones, Agronomist
Review Section 1
OPP/EFED/EFGWB

Signature:
Date: 26 AUG 1993

6.0 APPROVED BY:

Paul J. Mastradone, Ph.D.
Chief, Review Section 1
OPP/EFED/EFGWB

Signature:
Date: 26 AUG 1993

7.0 CONCLUSIONS:

7.1 The following environmental fate studies were submitted and have been reviewed for this RED. See DERs for details.

(a) Hydrolysis (161-1)

^{14}C-trichloromethyl captan hydrolyzed in sterile aqueous buffer solutions at pH 5, 7, and 9 with half-lives of 18.8 hr, 4.9 hr, and 8.3 min, respectively. Two unidentified degradates, both of which degraded rapidly to $^{14}CO_2$, were detected in the study. See attached DER for details.

Two previous captan hydrolysis studies were reviewed by EFGWB. One study (MRID 00096974; PJM - 08/30/85) partially fulfilled the data requirement by providing information on the hydrolysis of ^{14}C-carbonyl captan and describing the fate of the ring portion of the molecule in sterile aqueous solutions at a pH range of 2-9. Another study (MRID 40208101; LCL - 08/01/88) provided acceptable information on the hydrolysis of ^{14}C-trichloromethyl captan at pH 9.

Taken together, these three studies fulfill the data requirement. Hydrolysis is an important route of captan dissipation in the environment. No additional data on the hydrolysis of captan are needed at this time.

(b) Terrestrial field dissipation (164-1)

Six studies were submitted, all of which provide supplemental information.

Parent captan degraded with half-lives of 2.5 to 24 days and was relatively immobile to slightly mobile at six sites. The maximum depth at which captan was detected was 6-12 inches. The degradate tetrahydrophthalimide (THPI) was detected at all sites and declined to less than detectable (0.01 ppm) levels between 14 and 184 days after the final captan treatment. THPI was relatively immobile to slightly mobile in the study soils. Its maximum depth of detection was 6-12 inches.

Recurring problems make the studies difficult to interpret. Specifically:

(1) There was no field monitoring for THPAm which was detected in the aerobic soil metabolism study at up to 16.5% of the applied radioactivity. THPAm, which appears to be a degradation product of THPI, is potentially mobile based on Freundlich K_d values (0.18-0.43 in sand, loamy sand, and sandy loam soils; 11.51 in a clay loam) and was stable in an anaerobic soil metabolism study submitted for captafol (chem no. 081701, MRID 00026453; EAB review of 08/09/84).

(2) The validity of soil residue values is questionable in many cases due to:

- the use of a statistically invalid practice for analyzing some samples;
- poor stability of analytes in frozen storage; and
- failure to analyze many samples within the period covered by frozen storage stability data.

Viewed together, the field studies appear to provide relatively consistent estimates of the parent compound's half-life and the rates of formation and decline of THPI. However, due to several common problems, EFGWB has limited confidence in its ability to thoroughly assess the environmental fate of captan. A more complete assessment of captan dissipation can be made if field data are submitted which address the concerns identified above and in the attached reviews (see DERs for studies 2 through 7 and Recommendations below). The data requirement remains unfulfilled at this time.

(c) Bioaccumulation in fish (165-4)

Two studies, one each for cyclohexene-labeled and TCM-labeled captan, were submitted. Although neither study is completely acceptable, the data indicate that residues do not accumulate substantially in bluegill sunfish. Accumulated residues were largely eliminated during the depuration period. EFGWB therefore does not need additional fish accumulation data for captan at this time. See Discussion for details.

When exposed to a nominal concentration of 5 μg/L of ring-labeled ^{14}C-captan for 28 days, bluegill sunfish had ^{14}C bioaccumulation factors of 102X, 126X, and 113X for edible, non-edible, and whole fish tissue, respectively. After a 14-day depuration period, ^{14}C-residues in edible tissue, non-edible tissue, and whole fish declined by 94%, 96%, and 95%, respectively. Degradates in exposure water and fish metabolites were not identified.

7.2 Additional information was submitted for the following data requirements. Refer to Discussion (section 10 below) and EFGWB files for additional information.

(a) Photodegradation in water (161-2)

Because hydrolysis, not photolysis, was responsible for captan degradation in an aqueous photolysis study reviewed previously, EFGWB concluded that the photodegradation in water data requirement for captan would be fulfilled upon submission of acceptable hydrolysis data for pH 5.

Acceptable captan hydrolysis data at pH 5 have been submitted (see 7.1 [a] above). EFGWB concludes that captan is stable to photolysis in aqueous solution at pH 5. No additional photodegradation in water data for captan are required at this time.

(b) Photodegradation on soil (161-3)

In studies where ^{14}C-captan labeled in the cyclohexene and trichloromethyl positions was applied to moist sandy loam soil and irradiated with natural sunlight, captan degraded with registrant-calculated half-lives of 5 and 15 days, respectively. The registrant-calculated half-lives for dark controls were 10 and 21 days, respectively. After 5 days of irradiation of ^{14}C-cyclohexene captan, 21.3% of the applied radioactivity was present as tetrahydrophthalamide (THPI) and 9.4% was present as cyclohex-4-ene-2-cyano-1-carboxylic acid (THCY). No other single degradate contained >3.2% of the applied radioactivity. For ^{14}C-trichloromethyl captan, the only reported degradate was $^{14}CO_2$ which comprised 41.7% of the applied radioactivity after 16 days of irradiation.

The soil photolysis data submitted are acceptable and fulfill the data requirement. No additional data for captan photodegradation on soil are needed at this time.

(c) Accumulation in confined rotational crops (165-1)

EFGWB concludes that the study submitted and the response to the EFGWB review provide supplemental information. The study and additional information do not fulfill guidelines because the amount of captan applied to soil was not adequate to assess rotational crop uptake of residues. Additional data are needed to fulfill this guideline. These data should be submitted to HED which now reviews accumulation in confined rotational crops studies.

In lettuce, beets, and wheat planted 34 and 88 days after treatment with radiolabeled captan, residue levels (expressed as captan equivalents) were 0.005-1.822 ppm. Residue levels were lower in mature crops and in crops planted 88 days after treatment. The degradates THPI, THPAm, and THPI diol were detected in all crops harvested 9 days after planting. THPI diol was the only quantifiable captan degradate in plant tissue. Parent captan was not detected in any plant tissue at any time.

7.3 Environmental Fate Assessment

Although the laboratory database is nearly complete, the lack of complete field data limits EFGWB's ability to assess with confidence the environmental fate of captan. Data for terrestrial field dissipation, accumulation in confined rotational crops, and fish accumulation are deemed supplemental at this time. All other data requirements needed to support terrestrial food crop uses of captan have been fulfilled. The following assessment is taken from acceptable and supplemental studies.

Parent captan dissipates relatively rapidly via degradative processes. Hydrolysis and aerobic soil metabolism appear to be the major routes of captan dissipation in the environment. In water and soil, the sulfur-nitrogen bond cleaves separating the trichloromethyl and tetrahydrophthalimide (THPI) moieties of the molecule. The trichloromethylthio moiety degrades rapidly to CO_2 and inorganic sulfur and chlorine. THPI degrades to a series of ring-containing products and ultimately to CO_2. The fate of two major degradates, THPI and tetrahydrophthalamic acid (THPAm), cannot be assessed with confidence without additional field data. Photodegradation on soil also occurs, but is secondary to hydrolysis and aerobic soil metabolism. Direct and indirect evidence indicates that residues of THPI and THPAm may be present in soil several months following captan application. THPI (Freundlich K_d values were 0.076-0.76 in five soils) and THPAm (K_d values were 0.18-0.43 in sand, loamy sand, and sandy loam soils and 11.51 in a clay loam) are potentially mobile and may leach in the soil profile. THPAm was stable in an anaerobic soil metabolism study, and may not degrade rapidly at greater soil depths. THPI and THPAm may move with surface runoff.

7.4 Environmental Fate Summary

Captan hydrolyzes with a maximum half-life of 19 hr. Between pH 2 and 6, hydrolysis is pH-independent with rates increasing above pH 7. At pH 9, hydrolysis is very rapid ($t_{1/2}$ =<10 min). Degradation products include THPI and CO_2. Captan does not photodegrade in water.

In studies where ^{14}C-captan labeled in the cyclohexene and trichloromethyl positions was applied to moist sandy loam soil and irradiated with natural sunlight, captan degraded with registrant-calculated half-lives of 5 and 15 days, respectively. The registrant-calculated half-lives for dark controls were 10 and 21 days, respectively. Although photodegradation appeared to play a role in the decline of captan residues, aerobic soil metabolism was the process responsible for most degradation. After 5 days of irradiation of ^{14}C-cyclohexene captan, 21.3% of the applied radioactivity was present as tetrahydrophthalamide (THPI) and 9.4% was present as cyclohex-4-ene-2-cyano-1-carboxylic acid (THCY). No other single degradate contained >3.2% of the applied radioactivity. For ^{14}C-trichloromethyl captan, the only reported degradate was $^{14}CO_2$ which comprised 41.7% of the applied radioactivity after 16 days of irradiation.

Carbonyl-labeled captan incubated aerobically in a sandy loam degraded very rapidly with 99% degradation by day 7. Ninety-five percent of the originally applied ^{14}C was present as $^{14}CO_2$ after 322 days. THPI and THPAm were the major degradates identified. The maximum reported THPI concentration occurred at day 7 when 66% of the applied radioactivity was present in this degradate. THPAm reached its maximum reported concentration at day 14 when it comprised 16.5% of the applied radioactivity. Other soil metabolites of captan in quantities exceeding 0.01 ppm were tetrahydrophthalic acid (THPAI), 5,6 dihydroxyhexahydrophthalamide (diol), and THPI-epoxide. In an aerobic soil metabolism study using trichloromethyl (TCM)-labeled active ingredient, captan degraded with a half-life of <1 day in a sandy loam. After 1 day 46% of the applied radioactivity was detected as $^{14}CO_2$, 19.4% was undegraded captan, and 16.7% was unextractable ^{14}C residues. No non-volatile metabolites were detected. In a study submitted in support of captafol, a compound similar to captan in structure and degradation products, THPI degraded with a half-life of approximately 4 days. Degradation products were not identified.

After 1 day of aerobic incubation plus 29 days of anaerobic incubation, 4.0% of the radioactivity applied to a sandy loam soil was undegraded captan, 85.6% had evolved as $^{14}CO_2$, 0.8% was uncharacterized, and 16.6% was unextractable. About 80% of the parent captan had degraded during the 1-day aerobic period. In addition to THPI, THPAm, and THPAI, a cyano-acid metabolite of captan, THCY, was identified. Up to 20% of the applied radioactivity was detected as THCY. THCY and THPAm were stable in anaerobic conditions.

Volatility does not appear to be an important route of dissipation for parent captan. Over a 9-day period, approximately 0.003% of ring-labeled captan volatilized from a sand soil treated at a rate of 1 lb a.i./A. Approximately 3.9% of the applied radioactivity volatilized from TCM-labeled captan. None of the labeled volatiles was parent.

Soil TLC data indicate that captan is slightly mobile to relatively immobile (R_f 0.21-0.08) in various soils. These data, combined with the hydrolysis, soil metabolism, and terrestrial field data (see below) which indicate that captan is labile, demonstrate that the parent compound is not likely to leach significantly in soil. However, laboratory data submitted for captafol indicate that the degradates THPI and THPAm are mobile. Freundlich K_d values of 0.076-0.76 were reported for THPI in five soils. For THPAm, K_d values were 0.18-0.43 in sand, loamy sand, and sandy loam soils. In a clay loam, THPAm was relatively immobile with a K_d of 11.51.

Captan was applied to cropped plots in six terrestrial field dissipation studies (Oregon - grapes; Florida - tomatoes; California - strawberries and tomatoes; New York - apples; and Texas - cantaloupes). Parent captan dissipated from the upper 3 inches of soil with half-lives of 2.5-24 days and was immobile to slightly mobile. The deepest penetration into the soil profile was in one California study (strawberries) when it was detected at 0.03 ppm in the 6-12 inch depth at one sampling interval (following the sixth weekly captan application). THPI residues were monitored in the field studies and declined to less than detectable (<0.01 ppm) levels in the upper 3 inches of soil between 14 and 184 days after the final captan treatment. (In the Oregon study, the THPI residue level 184 days after final captan application was 0.017 ppm. Soil was not sampled after 184 days.) THPI was relatively immobile to slightly mobile in the study soils. The deepest penetration of THPI into the soil profile was in the New York study where it was detected at 6-12 inches (0.03 ppm) following the eighth and final captan application. THPAm was not monitored in any of the terrestrial field dissipation studies.

In immature lettuce, beets, and wheat planted 34 days after treatment with ring-labeled captan, residue levels (expressed as captan equivalents) were 0.060-1.822 ppm. In mature crops in the same treatment group, residues were 0.016-0.092 ppm. In immature crops planted 88 days following captan treatment, residue levels in immature crops were 0.013-0.12 ppm and in mature crops residues were 0.005-0.018 ppm. THPI diol, present at 0.532, 0.174, and 0.072 ppm in lettuce, beets, and wheat, respectively, was the only quantifiable captan metabolite in plant tissue. In similar studies using trichloromethyl-labeled captan, residues in immature and mature crops were 0.003-0.108 ppm. In mature crops, residues were 0.003-0.047 ppm. There were no identifiable residues in plant tissue in the TCM-treated group. Parent captan was not detected in any plant tissue at any time.

Captan residues showed little potential to bioaccumulate in bluegill sunfish. When exposed to a nominal concentration of 5 $\mu g/L$ of ring-labeled ^{14}C-captan for 28 days, bluegill sunfish had ^{14}C bioaccumulation factors of 102X, 126X, and 113X for edible, non-edible, and whole fish tissue, respectively. After a 14-day depuration period, ^{14}C-residues in edible tissue, non-edible tissue, and whole fish declined by 94%, 96%, and 95%, respectively.

7.5 The status of the environmental fate data requirements for captan for terrestrial food crop, terrestrial feed crop, indoor non-food, and residential outdoor uses is summarized below:

Environmental Fate Data Requirements	Status	MRID Number
Degradation		
161-1 Hydrolysis	Fulfilled (PJM - 08/30/85; LL - 08/01/88; AWJ - 08/26/93)	00096974 40208101 41176301
161-2 Photo. - water	Fulfilled (LL - 08/01/88; AWJ - 08/26/93)	40208102 41176301
161-3 Photo. - soil	Fulfilled (LL - 08/08/88) AWJ - 08/26/93)	40658009 40658010
161-4 Photo. - air	Not Required[1]	
Metabolism		
162-1 Aerobic soil	Fulfilled (PJM - (LL - 08/08/88)	00070414 40658007
162-2 Anaerobic soil	Fulfilled (LL - 08/08/88)	00098881 40658008
162-3 Anaerobic aqua.	Required[2]	
162-4 Aerobic aquatic	Required[2]	
Mobility		
163-1 Leaching, Ads./ Desorption	Fulfilled[3] (LL - 08/08/88 AWJ - 08/26/93)	40658011
163-2 Volatility-lab	Fulfilled (LL - 07/08/88)	40231001
163-3 Volatility-field	Not Required[1] (LL - 07/08/88)	
Dissipation		
164-1 Soil	Not fulfilled (AWJ - 08/26/93)	40823901, 40893601 40893602, 40893603 40932201, 40932202
164-2 Aquatic	Not required[4]	
164-3 Forest	Required[2]	
164-5 Soil, long-term	Not required	

Environmental Fate Data Reqmts (cont'd)		Status	MRID Number
Accumulation			
165-1	Conf rotat. crop	Not fulfilled[5] (AWJ - 04/14/92, 08/26/93)	41404001, 42378401
165-2	Field rotat. crop	Reserved[6]	
165-3	Irrigated crop	Not required[4]	
165-4	Fish	Not fulfilled[7] (AWJ - 08/26/93)	40756601, 40756602 40225601, 40225602
Spray Drift			
201-1	Drop size spec.	Not submitted[8]	
202-1	Drift field eval.	Not submitted[8]	

Footnotes:

[1] Because volatility does not appear to be an important route of dissipation, this study is not needed at this time.

[2] The most recent use information supplied to EFGWB (LUIS report of 09/10/91) indicates that captan has forestry use. These data are needed to support forestry use.

[3] EFGWB's review of 08/08/88 indicated that soil TLC data for parent captan were acceptable and that data were needed to assess the mobility of captan degradates. Freundlich K_d values for THPI and THPAm were submitted for captafol (chem no. 081701; MRID unknown; EAB review of 07/02/85). No additional mobility data are needed for captan or its degradates at this time.

[4] This study is not required at the present time because all aquatic uses for captan have been dropped (Captan Status Report, SRRD, 05/28/93)

[5] Supplemental data for the accumulation in confined rotational crops data requirement were submitted to EFGWB. Additional data are needed to fulfill this guideline. These data should be submitted to HED which now reviews these studies.

[6] This study is reserved pending the results of acceptable accumulation in confined rotational crops data.

[7] The data submitted were not completely acceptable. However, supplemental data indicate that residues did not accumulate significantly in bluegill sunfish. EFGWB does not need additional fish accumulation data at this time.

[8] These data may be requested by EFED/EEB and/or HED to support aerial and/or air blast application methods.

8.0 RECOMMENDATIONS:

8.1 To confirm laboratory study results and to enable a more comprehensive assessment of captan's behavior in the field, at least one field study is needed. Because parent captan is labile, emphasis should be placed on understanding the formation and dissipation of THPI and THPAm, the major degradates, in actual use conditions. The information gained from this study will enable EFGWB to determine the persistence and leaching potential of THPI and THPAm following multiple applications of captan.

EFGWB believes that this study should be conducted in regions where captan is used commonly. The following features should be incorporated into the experimental design:

- Captan should be applied to bare ground plots at the maximum labeled use rate to facilitate time zero recovery of analytes. The maximum number of applications allowed should be made. Soil residue levels should be a reasonable reflection of application rate. Bare ground treatment is essential in interpreting the field dissipation of a compound such as captan which is labile and often applied to foliage.

- The degradates THPI and THPAm should be monitored consistently.

- Analyses of multiple samples (i.e. multiple data points for each sampling interval) should be used to calculate the variability associated with captan's half-life and the dissipation of degradates.

- The study should be conducted on a relatively coarse-textured soil (e.g. sandy loam) which is low (<1.0%) in organic matter content. These conditions are needed to determine whether mobility may be a route of dissipation of captan degradates.

- Because captan and THPI appear to degrade in soil held in frozen storage, soil should be composited, extracted, and analyzed as soon as possible following sampling. Data confirming the relative stability of all analytes in soil under stored conditions will be needed.

- The studies should be conducted in cool climates where captan use is typical.

EFGWB will review and comment on a protocol for the studies if the registrant elects to submit one.

9. BACKGROUND:

Captan is a broad-spectrum fungicide used to control fungi on a wide variety of field crops, fruits, vegetables, and ornamentals. It is also used as a seed treatment and has industrial uses as well. The use groups are terrestrial food crop, terrestrial feed crop, greenhouse food, greenhouse non-food, indoor food, indoor non-food, and residential outdoor. Formulations include wettable powder, flowable concentrate, emulsifiable concentrate and liquid-ready to use. Captan may be applied as a dip, slurry, and by ground spray, air-blast, and aerial methods. Multiple applications of captan are common.

10.0 DISCUSSION:

See Conclusions, Recommendations, and DERs for additional information.

10.1 Photodegradation in water (161-2)

A study was submitted and reviewed by EFGWB (formerly EAB; EAB no. 70634-5; 08/01/88). The EAB review concluded that ^{14}C-trichloromethyl captan did not photodegrade in sterile aqueous buffer solution at pH 5. Because a 10-hr half-life was observed for both irradiated and dark control solutions, hydrolysis, not photolysis, was responsible for the degradation. Degradates were not identified because hydrolysis was the process governing degradation. The review also concluded that the photodegradation in water data requirement for captan would be fulfilled upon submission of acceptable hydrolysis data for pH 5.

Because acceptable captan hydrolysis data at pH 5 have been submitted (see 7.1 [a] above), the data requirement has been fulfilled. EFGWB concludes that captan is stable to photolysis in aqueous solution at pH 5. No additional photodegradation in water data for captan are needed at this time.

10.1 Photodegradation on soil (161-3)

EFGWB reviews of two earlier studies (MRID nos. 40658010 & 40658009; EAB no. 80862 - 08/08/88) indicated that additional information was needed to upgrade the studies to acceptable. The registrant submitted additional information for both studies (see attached letter dated 09/27/90 from A. Mueller, Captan Task Force to C. Peterson, SRRD).

MRID 40658010

The EFGWB review indicated that additional details concerning the experimental design and the source of some of the data were needed. One issue of concern to EFGWB was the method of application and the initial concentration of ^{14}C-captan in test soil. The registrant replied that some of the ^{14}C-captan particles in suspension remained in the pipette following application to the soil surface. This was complicated by weather conditions leading to illegible labels on petri dishes. Because of these problems, the initial concentration was determined by averaging the calculated doses for each petri dish. The radioactivity applied at all other time points was based on the calculated dose minus the material remaining in the pipettes.

Also of concern to EFGWB were material balances, which varied (the range was 83-121%) due to initial ^{14}C-captan concentrations being calculated rather than measured. The registrant acknowledged this problem and confirmed that the variability in material balance was due to the problem of captan insolubility in the application process.

MRID 40658009

The EFGWB review noted that this study, conducted with ^{14}C-trichloromethyl captan, consisted of two independent experiments conducted at different times using different stock solutions, application rates, light intensities, and sampling dates. The results of the two experiments were combined to estimate a half-life. The registrant replied that although the experiments were conducted under different conditions, the difference in captan concentrations at day 10 of each study (the only sampling time which occurred in both experiments) was relatively small. In one experiment, captan concentration 10 days after application was 58-65% of the applied. In the second experiment, captan was 68-81% of the applied at the same sampling time. In addition to this issue, problems similar to those for MRID 40654010 were noted by the EFGWB reviewer.

EFGWB believes that the differences in captan concentration 10 days after application are reasonable given differing experimental conditions. The soil photodegradation half-life reported in the study (15 days) appears to be a relatively good estimate based on the data presented.

In spite of the problems noted, EFGWB believes that the studies achieved their basic purpose, i.e. to assess soil photodegradation and to identify the nature and persistence of photoproducts formed by soil surface catalyzed photolysis. Soil surface photolysis appears to occur with captan, but other routes of dissipation, notably hydrolysis and soil metabolism, appear to be the principal routes of dissipation in the environment. EFGWB therefore believes that additional photodegradation on soil data will not add substantially to its understanding of the environmental fate of captan.

10.3 Accumulation in confined rotational crops (165-1)

EFGWB's review of 04/14/92 (MRID 41404001; EFGWB no. 90-0738) indicated that additional information concerning (1) frozen storage stability; (2) ^{14}C material balance; (3) selection of rotational intervals; (4) the number of applications; and (5) variability in soil residue measurements was needed. EFGWB's original comment, the registrant's responses, and EFGWB's rejoinders follow:

(a) Frozen storage stability

EFGWB 's original comment: Soil and plant samples were stored at -20°C, but the length of frozen storage time is not reported and frozen storage stability data were not presented. Storage stability for captan and its degradates must be demonstrated for the conditions of this study.

Registrant's response: Frozen storage stability for ring-labeled captan was addressed by one soil and one wheat forage sample which were extracted and analyzed 04/01/89 and 04/12/89, respectively. HPLC analysis of the same samples 6 months later "showed virtually identical metabolite profiles between the two time points."

In addition, non-radiolabeled storage stability data on captan and THPI were submitted (MRID 41551601 - attached) which "establish that for most crops examined over the course of 6-20 months, the stability of captan and THPI is approx. 70% or better."

EFGWB rejoinder: Although residue levels were not reported and only chromatograms were submitted, it appears that peak areas compare favorably for the initial and re-analysis of soil and wheat forage samples. However, it is not clear whether the 6-month interval between analyses covers the full period that soil and plant tissue were stored.

The storage stability data submitted under MRID 41551601 indicate that THPI is relatively stable in frozen plant tissue (parent captan, which degraded rapidly during the rotational interval, was not detected in plant tissues in the confined rotational crops study). Recoveries of comparable plant tissues were the following: soybean forage - 74% for 15 months; beet tops - 73% for 15 months; and wheat forage - 89% for 6 months.

Although recoveries after periods of frozen storage were less than optimal, EFGWB agrees that storage stability of soil and plant tissue has been sufficiently well documented.

(b) Poor accountability for applied radioactivity

EFGWB's original comment: The study indicates that there was low trapping efficiency for $^{14}CO_2$, but there was no attempt to use other available environmental fate data to explain the loss of radioactivity in the study. EFGWB believes that the loss of radioactivity should have been explained.

Registrant's response: "Mass balance is a supplemental requirement for this study. However, as indicated by the reviewer, the poor accountability for applied radioactivity is indeed due to the incomplete trapping of evolved $^{14}CO_2$ from the soil." The response elaborates on the difficulty of trapping $^{14}CO_2$ from the greenhouse flats and on previous captan aerobic soil metabolism studies which indicate rapid formation of $^{14}CO_2$.

EFGWB rejoinder: Although not a requirement for this particular study, EFGWB believes that every effort should be made to reach an acceptable mass balance when ^{14}C is used. When mass balance is not achievable, the loss of radioactivity should be explained with other available data rather than attributing it to poor trapping efficiency.

EFGWB believes that the explanation presented is adequate and that the lack of material balance does not compromise the study results.

(c) Selection of aging periods (rotational intervals)

EFGWB's original comment: The rationale for selecting 34- and 88-day aging periods was not presented. Rotational intervals should reflect typical agricultural uses of the chemical. The aging periods used should be explained fully.

Registrant's response: The 34-day interval was meant to approximate the standard 30-day interval and the 88-day period was meant to provide a reasonable worst-case approximation of the 120-day period. Planting earlier than 120 days gave a better opportunity for higher accumulation of residues to aid identification and characterization.

EFGWB rejoinder: Rotational intervals should reflect the typical agricultural uses of the chemical. It is not clear that the 34- and 88-day periods reflect real-world practices. However, given captan's rapid soil degradation, EFGWB agrees that the periods used were reasonable.

(d) Multiple vs. single applications of captan

EFGWB's original comment: Multiple applications of captan are allowed in field use, but only one application was made in this study. In accumulation in confined rotational crops studies, pesticide should be applied in a manner similar to its normal field use.

Registrant's response: "A single, higher-rate application of captan was made to approximate multiple applications. The single rates applied were exaggerated doses (approx. 3.5 lb/A for ring-labeled and 7.6 lb/A for TCM-labeled captan) relative to the amounts of captan expected on soil." (Note: According to the original study, the maximum captan application rate was 6.0 lb a.i./A, not 7.6 lb as indicated in the registrant's response.) Also, captan is foliar-applied in most cases, hence significant interception by the plant canopy (and correspondingly low amounts reaching soil) would be expected in normal use.

EFGWB rejoinder: EFGWB prefers that accumulation in confined rotational crops studies be conducted using normal practices. For captan, multiple applications are common. If a single application at an exaggerated rate is used, it must be equal to the sum total of all applications allowed at the maximum rate. The rates used in this study are well below the total amount of captan which can be applied to crops over a growing season. For example, eight applications at 3 lb a.i./A are allowed for strawberries (see DER for study 5), hence the confined rotational crops study should use a single application of at least 24 lb a.i./A. EFGWB concludes that this procedure may have reduced residue accumulation in rotational crops.

(e) Wide variability in soil residue measurements

EFGWB's original comment: The time zero concentrations in soil treated with TCM-labeled captan varied widely between the flats sampled. In the

0-3 inch layer, the time zero residue concentrations were 0.93, 1.85, and 5.45 ppm. At 34 days after treatment, TCM-labeled residues were at the detection limit (0.003 ppm), but then increased at days 88 (0.095 ppm) and 224 (0.166 ppm). Apparently there were no soil fortifications to determine the applicability of the soil analytical method.

Registrant's response: "The wide variability in soil measurements is not a function of the soil analytical method, since the captan was radio-labeled and the total radioactive residue was determined by combustion. The likely cause of the wide variability was the inhomogeniety of the original aqueous treatment suspensions and subsequent uneven application to the flats. Parent captan has low aqueous solubility and would not disperse evenly into the soil with water." Offsetting factors to soil residue variability were extensive root growth of crops (which presumably "sampled" the soil thoroughly for residue uptake; three 1-inch soil cores would be expected to yield variable results) and the relatively low variability among soil residues when crops were planted 34 days after treatment.

EFGWB rejoinder: EFGWB does not believe that the response adequately explains the wide variability in soil residue measurements. Although some variability is expected, soil measurements should demonstrate reliably the quantity of residues available for plant uptake.

In summary, the additional information supplied does not address adequately all of the concerns identified in the original study. Of particular concern is the single application of captan and relatively low residue levels in soil which could reduce residue uptake by rotational crops. The data are supplemental and the data requirement remains unfulfilled at this time. Additional data for this guideline should be submitted to HED.

10.4 Bioaccumulation in fish (165-4)

Two studies, one each for cyclohexene-labeled and TCM-labeled captan, were submitted (see Conclusions and DERs attached). Although neither study was acceptable, residue accumulation in fish tissue was low and depuration of residues was relatively rapid and complete. EFGWB therefore does not need additional data in support of this guideline at this time. See Conclusions and DERs for additional information.

The registrant submitted two reports in addition to the studies reviewed. The first of these, MRID 40225601, is an excerpt from the EPA publication Initial Scientific and Minieconomic Review of Captan, April 1975 (EPA-540/1-75-012). The pertinent part of this document summarizes a captan bioaccumulation study prepared for EPA's Water Quality Office by the Illinois Natural History Survey. The study involved a laboratory terrestrial-aquatic model ecosystem which simulated pesticide application to crops and subsequent contamination of the aquatic environment. The study concluded that captan did not persist in the aquatic environment and did not accumulate in fish which were the upper member of the aquatic food chain. EFGWB considers this to be supplemental information. Since the original paper was not submitted for review, the study cannot be used toward fulfillment of the 165-4 data requirement.

The second report, MRID 40225602, is an open literature study (Kenaga, E.E. 1980. Predicted bioconcentration factors and soil sorption coefficients of pesticides and other chemicals. Ecotox and Environ Safety 4: 26-38). The study reports on the use of equations to calculate soil sorption coefficients (K_{oc}) and bioconcentration factors of 358 compounds, mostly pesticides, based on water solubility.

Based on a reported water solubility of <0.5 ppm, captan's predicted bioconcentration factor is >910. (It should also be noted that EFGWB's records show captan's aqueous solubility to be 3.3 ppm). In a study submitted in support of reregistration, captan's reported bioconcentration factor in whole bluegill sunfish was 113 (see DER for study 8). At this time EFGWB is not convinced that bioconcentration factors and soil sorption can be predicted reliably from aqueous solubility. This paper does not provide information which can be used to support captan reregistration.

11. <u>COMPLETION OF ONE-LINER:</u> Updated one-liner attached.

12: <u>CBI APPENDIX:</u> N/A

Environmental Fate & Effects Division PESTICIDE ENVIRONMENTAL FATE ONE LINE SUMMARY **CAPTAN** Last Update on September 16, 1993 [V] = Validated Study [S] = Supplemental Study [U] = USDA Data			
LOGOUT	Reviewer:	Section Head:	Date:

Common Name:CAPTAN
Smiles Code:ClC(Cl)(Cl)SN(C(=O)C1CC=2)C(=O)C1CC2
PC Code # : 81301 CAS #:133-06-2 Caswell #:

Chem. Name :N-(TRICHLOROMETHYLTHIO)-4-CYCLOHEXENE-1,2-DICARBOXIMIDE

Action Type:Fungicide

Trade Names: CAPTANEX; CAPTAF; MERBAN
(Formul'tn):WP,SP, D, Seed Treatment
Physical State: CLRLESS CRYSTALS;TECH YLW

Use	:Variety of fruit, vegetable, nut, and ornamental crops
Patterns	:seed treatment; postharvest dip; nonfood uses; incorporated
(% Usage)	:into plastics, paints, pastes, textiles, paper and cosmetics
	:

Empirical Form: $C_7H_8NSCl_3O_2$
Molecular Wgt.: 300.59 Vapor Pressure: 8.00E -8 Torr
Melting Point : 178 °C Boiling Point: N/A °C
Log Kow : pKa: @ °C
Henry's : E Atm. M3/Mol (Measured) 9.59E-10 (calc'd)

Solubility in ...					Comments
Water	3.30E 1	ppm	@	°C	
Acetone	E	ppm	@	°C	
Acetonitrile	E	ppm	@	°C	
Benzene	E	ppm	@	°C	
Chloroform	E	ppm	@	°C	
Ethanol	E	ppm	@	°C	
Methanol	E	ppm	@	°C	
Toluene	E	ppm	@	°C	
Xylene	E	ppm	@	°C	
	E	ppm	@	°C	
	E	ppm	@	°C	

Hydrolysis (161-1)
[V] pH 5.0:12-19 hr
[V] pH 7.0:5-6 hr
[V] pH 9.0:3.6-8 min
[ ] pH :Half-lives varied slightly in studies where molecule was la-
[ ] pH :beled in different positions. Hydrolysis is important route
[ ] pH :of dissipation.

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Photolysis (161-2, -3, -4)
[S] Water:10 HRS (pH 5), THE SAME
[ ] :TIME AS IN HYDROLYSIS, THUS
[ ] :NO PHOTOLYSIS TOOK PLACE.
[ ] :

[S] Soil :5-15 days
[ ] Air :

Aerobic Soil Metabolism (162-1)
[V] TETRAHYDROPH-LABELED-10PPM-SdLm T1/2=3D; 99% DEGRADED IN 7 DAYS
[ ] (MRID# 00070414)
[V] TCM-LABELED-6.1 PPM-SdLm-T1/2=<1 DAY; NO NONVOL. DEGR.; AT 1 DAY
[ ] 19.5% OF RADIOACT. WAS UNDEGRADED CAPTAN; 46% WAS CO2 (MRID#
[ ] 40658008)
[V] THPI, MAJOR DEGRADATE, T1/2=4 DAYS (SEE CAPTAFOL FILE). THPAM
[ ] IS ALSO IMPORTANT DEGRADATE.

Anaerobic Soil Metabolism (162-2)
[V] TCM-LABELED-6.1 PPM-AFTER 1d
[ ] AEROBIC + 29d ANAEROBIC, 4% OF
[ ] RADIOACTIVITY WAS CAPTAN;85.6%
[ ] WAS CO2. THPI, MAJOR DEGRADATE, T1/2=40 DAYS (00070414)
[ ]
[ ]
[ ]

Anaerobic Aquatic Metabolism (162-3)
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

Aerobic Aquatic Metabolism (162-4)
[ ]
[ ]
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[ ]

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Soil Partition Coefficient (Kd) (163-1)

[V] Kd (ESTIMATED FROM Rf) = 3 TO 8 FOR SOILS BELOW (MRID# 40658011)
[ ] Kd's for degradate THPI = 0.076-0.76 in 5 soils.
[ ] Kd's for degradate THPAm = 0.18-0.43 in sand, loamy sand, and
[ ] sandy loam; 11.51 in clay loam. Kd's for THPI and THPAm were
[ ] obtained from data submitted for captafol.
[ ]

Soil Rf Factors (163-1)

[V] CROWLEY ClLm .21
[V] MACKSBURY SiClLm .15
[V] NICOLLET ClLm .14
[V] OAKLEY SdLm .09
[V] STOCKTON ADOBE CLAY .08
[ ] (MRID# 40658011)

Laboratory Volatility (163-2)

[V] 0.003% OF APPL. RADIOACTIVITY VOL. AFTER 9 DAYS FROM RING-LABELED
[ ] SLIGHTLY MORE VOL. (3.9% OF APPL) FROM TCM-LABEL (MRID# 40231901)

Field Volatility (163-3)

[ ]
[ ]

Terrestrial Field Dissipation (164-1)

[S] Half-lives were 2.5-24 days at six sites (OR, FL, CA [2 sites],
[ ] NY, TX. Captan and THPI were detected at 6-12". No field moni-
[ ] toring for THPAm.
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

Aquatic Dissipation (164-2)

[ ]
[ ]
[ ]
[ ]
[ ]
[ ]

Forestry Dissipation (164-3)

[ ]
[ ]

Long-Term Soil Dissipation (164-5)
[ ]
[ ]

Accumulation in Rotational Crops, Confined (165-1)
[S] IN LETTUCE, BEET, WHEAT - RESIDUES 0.005-1.822PPM 34 & 88D ROTAT.
[ ] INT; RESIDUES LESS IN TCM-LABELED (MRID# 41404001). SEE COMMENTS.

Accumulation in Rotational Crops, Field (165-2)
[ ]
[ ]

Accumulation in Irrigated Crops (165-3)
[ ]
[ ]

Bioaccumulation in Fish (165-4)
[S] BCF = 102X, 126X, and 113X for filet, viscera, and whole bluegill
[ ] 94-96% depuration after 14d. No addl data needed at present.

Bioaccumulation in Non-Target Organisms (165-5)
[S] EC50 FOR THE ALGA SCENEDESMUS SUBSPICATUS WAS
[ ] .32 MG/L.

Ground Water Monitoring, Prospective (166-1)
[ ]
[ ]
[ ]
[ ]

Ground Water Monitoring, Small Scale Retrospective (166-2)
[ ]
[ ]
[ ]
[ ]

Ground Water Monitoring, Large Scale Retrospective (166-3)
[ ]
[ ]
[ ]
[ ]

Ground Water Monitoring, Miscellaneous Data (158.75)
[ ]
[ ]
[ ]

Field Runoff (167-1)
[ ]
[ ]
[ ]
[ ]

Surface Water Monitoring (167-2)
[ ]
[ ]
[ ]
[ ]

Spray Drift, Droplet Spectrum (201-1)
[ ]
[ ]
[ ]
[ ]

Spray Drift, Field Evaluation (202-1)
[ ]
[ ]
[ ]
[ ]

Degradation Products

δ4-tetrahydrophthalimide (THPI)
δ4-tetrahydrophthalimic acid (THPAm)
N-(trichloromethylthio)-4,5-epoxyhexahydrophthalimide
4,5-epoxyhexahydrophthalimide
3-hydroxy-δ4-tetrahydrophthalimide
5-hydroxy-δ4-tetrahydrophthalimide
δ4-tetrahydrophthalic acid
4,5-dihydroxyhexahydrophthalimide
phthalimide
3-hydroxy-δ4-tetrahydrophthalamic acid

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Comments

IN CONFINED ROT. CROPS, THPI, THPAM, AND THPI DIOL DETECTED; ONLY THPI DIOL QUANTIFIED (0.072-0.532 PPM) IN IMMATURE LETTUCE, BEETS, AND WHEAT 34 DAYS FOLLOWING CAPTAN APPLICATION.

DEGRADATES THPI AND THPAm ARE POTENTIALLY MOBILE BASED ON Kd's. THPAm APPEARS TO BE PERSISTENT IN ANAEROBIC SOIL.

References: FILES, EFGWB List A RED Chapter (09/07/93)
Writer : Updated 09/16/93 by AJones

Surface Water Assessment of Captan (4/28/95 for EFGWB RED)

Substantial amounts of captan could be available for runoff to surface waters for only a few days to several weeks post-application (aerobic soil metabolism half-life of < 1 to 3 days, terrestrial field dissipation half-lives of 2.5 to 24 days). The relatively low soil/water partitioning of captan (SCS/ARS database K_{oc} of 200; K_d = 3-8) for 4 soils indicates that most captan runoff will be via dissolution in runoff water as opposed to adsorption to eroding soil.

Captan is not susceptible to direct aqueous photolysis or to volatilization from water (estimated Henry's Law constant = 9.6 X 10^{-10} atm*m^3/mol). However, captan is susceptible to rapid abiotic hydrolysis (half-lives of 12-19 hours at pH 5, 5-6 hours at pH 7, and 6-8 minutes at pH 9). It is also susceptible to fairly rapid microbiological degradation under both aerobic and anaerobic conditions. Consequently, it should not persist in surface waters under most hydrological or chemical conditions. Its relatively low soil/water partitioning indicates that most of the captan in surface waters will be dissolved in the water column as opposed to adsorbed to suspended and bottom sediment. Reported BCFs for captan of 102X to 113X indicate that its bioaccumulation potential is relatively low.

The major degradates of captan are 4-tetrahydrophthalimide (THPI) and 4-tetrahydrophthalimic acid (THPAM). Both exhibit low soil/water partitioning (K_d values < 1) which indicates that most of their runoff will be via dissolution in runoff water as opposed to adsorption to eroding soil. Both degrade at rates comparable to those of captan (relatively rapidly) under aerobic conditions, but THPZAM is reported to be much more persistent under anaerobic conditions.

The State of Illinois (Moyer and Cross 1990) sampled 30 surface water sites for pesticides at various times from October 1985 through October 1988. Substantial use in Illinois was a criteria for pesticides being included in the analyses. Total (dissolved and adsorbed to suspended sediment) captan was not detected above a detection limit of 0.05 ug/L in any of 580 samples collected from the 30 sites sampled.

Sam Mostaghimi of EFGWB has used computer modeling to generate Tier 2 (single site over multiple years) EECs for captan in a 1 ha surface area, 2 m deep pond draining 10 ha almond, apple, peach, prune, cherry and blueberry fields. The EECs were generated for use by EEB in performing aquatic risk assessments. One site was modeled for each crop. Information on the sites and soils modeled are contained in report D210410 dated 3/21/95. Each site represents reasonable high exposure and was simulated over 36 years. The 1 in 10 years EECs, assumed application rates, and assumed number of applications for each site were listed in Table 1 of the report (attached).

Captan is not currently regulated under the Safe Drinking Water Act (SDWA). Therefore no MCL has been established for it and water supply systems are not required to sample and analyze for it. Drinking water health advisory levels (HALs) have not been established for it either. Furthermore, the rapid degradation of captan in surface water should limit its annual average concentration (which would be compared to the MCL if captan had one). Therefore, EFGWB is not currently recommending that captan be monitored for in surface water source supply systems. In addition, EFGWB does not currently believe that the potential risks of captan to fish and aquatic invertebrates is sufficient to warrant recommending surface water monitoring as a condition for reregistration. However, EFGWB defers to EEB on questions concerning potential risks to aquatic organisms.

EFGWB does not currently believe that surface water labeling is needed for captan. However, if a decision is made to generate a labeling surface water advisory for captan, EFGWB recommends the following wording:

Captan can contaminate surface water through spray drift.
Under some conditions, captan may also have a high potential for runoff into surface water (primarily via dissolution in runoff water), for several days post-application. These include poorly draining or wet soils with readily visible slopes toward adjacent surface waters, frequently flooded areas, areas over-laying extremely shallow ground water, areas with in-field canals or ditches that drain to surface water, areas not separated from adjacent surface waters with vegetated filter strips, areas over-laying tile drainage systems that drain to surface water, and areas where an intense or sustained rainfall is forecasted to occur within 48 hours.

by a cover crop. The cover crop either is left alone during the growing season or plowed under.

Table 1. Estimated Environmental Concentrations (EEC's) for Captan. Results reported are 1 in 10 year maximum values with 5 % spray drift.

Crop	Application Method	Applica. Rate lb a.i/Acre (Number of Applications)	Max Initial EEC (PPB)	4 DAY EEC (PPB)	21 DAY EEC (PPB)	60 DAY EEC (PPB)	90 DAY EEC (PPB)
Almonds, California	Spray Blast	5.25 (6)	216.8	56.6	14.5	10.6	8.2
Apples, New York	Spray Blast	4.5 (7)	102.0	28.4	6.2	5.0	3.6
Peaches, South Carolina	Spray Blast	4.0 (8)	546.8	111.2	24.9	17.5	13.4
Prunes, California	Spray Blast	3.0 (9)	118.2	30.8	7.9	5.7	4.6
Cherries, California	Spray Blast	2.0 (7)	28.0	5.5	2.7	2.3	1.7
Blueberries, Michigan	Spray Blast	2.5 (14)	161.0	33.4	8.0	6.5	4.7

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

5/17/95

MEMORANDUM

SUBJECT: Revision to EFGWB RED Science Chapter on Captan

TO: Lois Rossi, Chief
Reregistration Branch
Special Review and Reregistration Division (7508W)

AND: Evert Byington, Chief
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (7507C)

FROM: Estella Waldman, Hydrologist
Ground Water Technology Section
EFGWB/EFED (7507C)

THRU: Elizabeth Behl, Head
Ground Water Technology Section
EFGWB/EFED (7507C)

Henry M. Jacoby, Chief
Environmental Fate and Groundwater Branch
Environmental Fate and Effects Division (7507C)

Henry Jacoby 5/16/95

Conclusions

The environmental fate characteristics of parent captan indicate that it will probably not be a major ground-water contaminant. However, limited information suggests that two of its degradates -- THPI and THPAm -- may leach to ground water. Because this information is limited, a field dissipation study was recommended in the original EFGWB chapter to assess the leaching potential of these degradates. The leaching potential of captan should be re-evaluated once the results of the field dissipation study are available.

Background

A recent RED science chapter completed by EFGWB for captan indicated that two of its degradates (THPI) and (THPAm) may be sufficiently mobile and persistent to leach to ground water. However, environmental fate information for these degradates is limited and at present the fate cannot be assessed with confidence. Information indicating stability under anaerobic conditions is somewhat more definitive for THPAm than THPI; both degradates are highly mobile in many soils. As stated in the RED chapter, "direct and indirect evidence indicates that residues of THPI and THPAm may be present in soil several months following captan application."

The EFGWB RED chapter also stated a recommendation for a field dissipation study to specifically monitor the fate of the degradates under actual use conditions. Results of this study would be used to determine the persistence, mobility, and leaching potential of THPI and THPAm.

Parent captan is a B2 carcinogen for which no MCL or health advisory level has been established. THPI is not a carcinogen but it is compared to and regulated under the reference dose for animals. THPAm is not considered toxic (Mike Metzger, HED, 5/8/95).

Captan has been detected in ground water in four wells in California with concentrations ranging from 0.1 to 0.5 ppb. The wells fed public supply water systems that were considered "vulnerable" and the detections were probably from nonpoint sources. The wells were resampled and no residues were found (Kay Newhart, CA Department of Pesticide Monitoring, 5/11/95). Monitoring in approximately 700 wells in seven other states showed no evidence of captan contamination. No monitoring information is available for THPI or THPAm (Pesticides in Ground Water Database, 1992).

Recommendations

The degradate THPI has the potential to exceed the levels of concern for ground water but sufficient information is not available at present to make a definitive assessment. Results from the previously recommended field dissipation study would be very useful in determining the leaching potential of this degradate. EFGWB again recommends that this study be conducted.

The leaching potential of captan should be re-evaluated once the results of the field dissipation study are available. Further recommendations should be made at that time.

DP BARCODE: D207650

REREG CASE # 012

CASE: 819260
SUBMISSION: S473829

DATA PACKAGE RECORD
BEAN SHEET

DATE: 09/22/9
Page 1 of 1

* * * CASE/SUBMISSION INFORMATION * * *

CASE TYPE: REREGISTRATION ACTION: 629 GENERAL CORRESPONDENCE
CHEMICALS: 081301 Captan 100.00

ID#: 081301
COMPANY:
PRODUCT MANAGER: 73 LINDA PROPST 703-308-8165 ROOM: CS1 2B3
PM TEAM REVIEWER: DENNIS MCNEILLY 703-308-8066 ROOM: CS1 3F5
RECEIVED DATE: 09/22/94 DUE OUT DATE: 12/21/94

* * * DATA PACKAGE INFORMATION * * *

DP BARCODE: 207650 EXPEDITE: N DATE SENT: 09/22/94 DATE RET.: / /
CHEMICAL: 081301 Captan
DP TYPE: 999 Miscellaneous Data Package
CSF: N LABEL: N

ASSIGNED TO	DATE IN	DATE OUT
DIV : EFED	09/23/94	/ /
BRAN: EEB	[illegible]	3/30/95
SECT:	09/26/94	/ /
REVR :	Felkel 09/26/94	/ /
CONTR:	/ /	/ /

ADMIN DUE DATE: 12/06/94
NEGOT DATE: / /
PROJ DATE: / /

* * * DATA REVIEW INSTRUCTIONS * * *

Attn: Henry Craven
Attached is new LUIS Report, FR notices of cancellation of captan uses and use information submitted by the task force. Note; no forestry uses, Can EEB proceed with RED? If not, what additional data are required given the updated use information and the new paradigm?

* * * DATA PACKAGE EVALUATION * * *

No evaluation is written for this data package

* * * ADDITIONAL DATA PACKAGES FOR THIS SUBMISSION * * *

DP BC	BRANCH/SECTION	DATE OUT	DUE BACK	INS	CSF	LABEL

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 30 1995

MEMORANDUM

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

SUBJECT: Captan RED

FROM: Anthony F. Maciorowski
Ecological Effects Branch/EFED

TO: Mary Frankenberry
SACS/EFED

Enclosed are the following:

1. EEB's chapter for captan

2. Data Requirements Table

Levels of Concern Exceeded

The following are the Levels of Concern (LOC) that are (or could be) exceeded in this analysis:

1. For avian acute risk, there are no definitive risk quotients to compare to the LOCs since definitive LC50s are not available (i.e. no mortality reported at the highest test levels). Similarly for avian chronic risk, no effects were reported at the highest test level. However, EECs sometimes exceed these levels. Avian dietary and reproduction testing at higher exposures, sufficient to produce definitive toxicity values, would be needed to provide definitive risk quotients.

2. For small wild mammal acute risk, with a single application, the high acute LOC is exceeded for turf and almonds. The restricted use and endangered species acute LOCs are exceeded for all sites modeled. With repeat applications, the high acute risk, restricted use, and endangered species acute LOCs are exceeded for all sites modeled. Chronic LOCs would be exceeded for all the sites evaluated, since the lowest chronic toxicity values are considerably lower than acute values.

3. The fish high acute risk, restricted use and endangered species acute LOCs are exceeded for all modeled sites.

4. The aquatic invertebrate restricted use LOC is exceeded for the following modeled sites: single foliar turf

1. 71-2(a) Acute avian dietary, quail. Additional testing at > 5000 ppm, sufficient to produce a definitive LC50, would enable EEB to calculate definitive risk quotients (see above).

2. 71-2(b) Acute avian dietary, duck. Additional testing at > 5000 ppm, sufficient to produce a definitive LC50, would enable EEB to calculate definitive risk quotients (see above).

3. 71-4(a) Avian reproduction, quail. Additional testing at > 1000 ppm would enable EEB to determine whether exposures at > 1000 ppm may pose a hazard.

4. 71-4(b) Avian reproduction, duck. Additional testing at > 1000 ppm would enable EEB to determine whether exposures at > 1000 ppm may pose a hazard.

5. 72-1(b) Acute fish toxicity, bluegill (TEP). Formulated product testing will enable EEB to determine whether the tested formulation(s) are more toxic than would be expected based on active ingredient alone.

6. 72-1(d) Acute fish toxicity, rainbow trout (TEP). Formulated product testing will enable EEB to determine whether the tested formulation(s) are more toxic than would be expected based on active ingredient alone.

7. 72-3(a) Acute estuarine/marine toxicity, fish. Estuarine/marine testing will enable EEB to evaluate risk for estuarine/marine species expected to be exposed in uses including apples, cherries, pears, vegetables, and turf.

8. 72-3(b) Acute estuarine/marine toxicity, mollusk. See #7.

9. 72-3(c) Acute estuarine/marine toxicity, shrimp. See #7.

10. 72-4(b) Life-cycle, aquatic invertebrate. EEB currently has no chronic aquatic invertebrate data for captan. This data would enable EEB to specifically address chronic risk to aquatic invertebrates.

11. 122-1(a) Seedling emergence. No data for captan are currently available. This data would enable EEB to assess risk to exposed nontarget terrestrial plants.

12. 123-1(b) Vegetative vigor. See #11.

13. 123-2 Aquatic plant growth. Effects were seen in testing with one non-recommended test species. Additional testing with the five recommended species will enable EEB to complete a risk assessment for aquatic plants exposed to captan.

14. 200-1, 202-1 Spray drift studies. These studies will enable

applications and multiple spray blast applications to almonds, peaches, and blueberries. The endangered species acute LOC is exceeded for all modeled sites, except cherries. Chronic effects to aquatic invertebrates cannot be evaluated until submission of chronic toxicity data.

5. A terrestrial plant risk assessment and full aquatic plant risk assessment will be conducted following submission of specified Tier 1 and Tier 2 testing. Based on the one aquatic plant test available, high risk and endangered species LOCs are exceeded for the turf and peach uses that were modeled.

A wide range of use sites and rates have been modeled, by EFGWB and EEB. The above conclusions would also apply to any other sites within the modeled range. As seen above, captan meets certain criteria for when the Agency may initiate the special review process [e.g.,"May result in residues in the environment of nontarget organisms at levels which equal or exceed concentrations acutely or chronically toxic to such organisms..." (40 CFR 154.7(a)(3)].

Risk Reduction Measures

To reduce terrestrial and aquatic risk would require reducing terrestrial and aquatic exposure, respectively. Exposure can be reduced by lowering maximum application rates on the labels and/or eliminating or reducing repeat applications and/or increasing treatment intervals, for example. Risk quotients can be reduced in direct proportion to a reduction in the EECs, for the given toxicity values.

For example, if the high turf maximum rate were reduced and/or all labels clearly prohibited captan use in a manner to which the current GENEEC model would apply, aquatic EECs could be re-calculated. Terrestrial EECs could be re-calculated if the rate changed. A full evaluation of the turf use pattern (including any EEC re-calculation) requires information concerning repeat applications.

As indicated below, there are additional data required to complete a risk assessment. New data may indicate new concerns but would not mitigate existing concerns, since EEB uses the lowest valid toxicity values (i.e., highest toxicity) for risk assessment.

Value of Additional Data

As indicated in the data table, additional data to complete a risk assessment are listed in 14 categories with further data requirements reserved (i.e., pending submission and review of other data) in seven categories. This is in addition to any requirements for data on captan degradates. The following outlines the value of this additional data.

EEB to evaluate the captan uses involving aerial, air blast, or chemigation application methods.

Recently-approved additions to 40 CFR, Part 158 include sediment toxicity testing. At present, EEB does not have final criteria for when this testing is needed.

EFGWB has identified a number of degradates/metabolites in its 9/7/93 review. The Agency needs to evaluate what additional testing specifically on degradates/metabolites may be needed to complete a risk assessment.

EFGWB has provided EEB with a rough approximation of captan foliar half-life, based partly on dislodgeable residue data from OREB. Data to enable improved evaluation of foliar persistence by EFGWB would enable EEB to improve terrestrial risk assessments.

Labeling

1. Manufacturing-Use (incl. PR Notice 93-10)

   This pesticide is toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

2. End-Use (incl. PR Notices 93-3, 93-8)

   Seed Treatments (per H. Craven): This pesticide is toxic to fish. Do not contaminate water when disposing of equipment washwaters or rinsate.

   Other Uses: This pesticide is toxic to fish. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters or rinsate.

As noted above, the criteria for restricted use have been exceeded for all modeled sites.

If you have any questions please contact Harry Craven (305-5320) or James Felkel (305-5828).

C. ENVIRONMENTAL ASSESSMENT

1. Ecological Toxicity Data

EFED does not have adequate data needed to fully assess the hazard of captan to nontarget terrestrial and aquatic organisms.

a. Toxicity to Terrestrial Animals

(1) Birds, Acute and Subacute

In order to establish the toxicity of captan to birds, the following tests are required using the technical grade material: one avian single-dose oral (LD_{50}) study on one species (preferably mallard or bobwhite quail); two subacute dietary studies (LC_{50}) on one species of waterfowl (preferably the mallard duck) and one species of upland game bird (preferably bobwhite quail).

Avian Acute Oral Toxicity Findings

Species	% A.I.	LD_{50} mg/kg	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement*
Northern bobwhite	Tech.	> 2,150	GS0120-045 Beavers, 1985	"practically nontoxic"	Y
Northern bobwhite	50%	> 2,510 (test material)	00151236 Wildlife Int., 1978	"practically non-toxic"	S
Mallard Duck	Tech.	> 2000	GS9999-001 Hudson, et. al., 1984	"practically nontoxic"	Y
Starling	Tech.	> 100	00020560 Schafer, 1972	"moderately, slightly, or practically nontoxic"	S
Redwinged blackbird	Tech.	> 100	00020560 Schafer, 1972	"moderately, slightly, or practically nontoxic"	S

*Y=Acceptable (Study satisfied Guideline)/Concur P=Partial (Study partially fulfilled Guideline but additional information is needed)
S=Supplemental (Study provided useful information but Guideline was not satisfied) N=Unacceptable (Study was rejected)/Nonconcur

Avian Subacute Dietary Toxicity Findings					
Species	% A.I.	LC_{50} ppm	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Northern Bobwhite	Tech.	> 2,400	00022923 Hill et al., 1975	"slightly toxic or practically non-toxic"	Y
Japanese quail	Tech.	> 5000	Ibid.	"practically non-toxic"	S
Ring-necked pheasant	Tech.	> 5000	Ibid.	"practically non-toxic"	Y
Mallard	Tech.	> 5000	Ibid.	"practically non-toxic"	Y
Northern bobwhite	Tech.	> 4640	00104686 Fink, et. al., 1980	"slightly toxic or practically non-toxic"	S

These results indicate that the captan test material is "practically non-toxic" to the test species on an acute oral basis when the LD50 is > 2000 mg/kg, and on a subacute dietary basis when the LC50 is > 5000 ppm. When the toxicity values are only known to be greater than a value smaller than these, it is not known for sure what toxicity category a definitive value would fall in, as shown in the tables. The guideline requirements are fulfilled for exposures up to the tested levels. Additional testing with the northern bobwhite and mallard are needed at levels > 5000 ppm because of high EECs (see risk assessment).

(2) **Birds, Chronic**

Avian reproduction studies are required when birds may be exposed repeatedly or continuously through persistence, bioaccumulation, or multiple applications, or if mammalian reproduction tests indicate reproductive hazard. For example, many captan end-use product labels allow multiple applications per growing season.

Avian Reproduction Findings						
Species	% A.I.	NOEL ppm	LOEL ppm	Endpoints affected	MRID No. Author/Year	Fulfills Guideline Requirement
Northern bobwhite	Tech	1000 ppm	——	——	00098295 Fink, 1980	Y
Mallard duck	Tech	1000 ppm	——	——	00098296 Fink, 1980	Y

The avian reproduction studies indicate that exposure at up to 1000 ppm in the diet does not appear to affect reproduction. The guideline requirements are fulfilled for products with application rates resulting in residues $\leq$ 1000 ppm. Testing at higher levels is needed to assess risk for uses producing residues > 1000 ppm.

(3) **Mammals**

Wild mammal testing is required on a case-by-case basis, depending on the results of the lower tier studies such as acute and subacute testing, intended use pattern, and pertinent environmental fate characteristics. In most cases, however, an acute oral LD_{50} from the Agency's Health Effects Division (HED) is used to determine toxicity to mammals (HED Tox Oneliners). This LD_{50}, which appears to be the lowest available on technical material, is reported below.

Mammalian Acute Oral Toxicity Findings			
Species	LD_{50} mg/kg	MRID #	Toxicity Category
Rat (small mammal surrogate)	1360 mg/kg	266077	"slightly toxic"

The available mammalian data indicate that captan is "slightly toxic" to the test species on an acute oral basis.

(4) **Insects**

A honey bee acute contact LD_{50} study is required if the proposed use will result in honey bee exposure.

Nontarget Insect Acute Contact Toxicity Findings					
Species	% AI	LD_{50} µg a.i./bee	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Honeybee	Tech.	9.8% mortality at 215 ug/bee	00080871 Atkins, et. al., 1972	"relatively nontoxic"	Y
Honeybee	Tech.	> 10	05001991 Stevenson, 1978	"relatively nontoxic"	Y

There is sufficient information to characterize captan as "relatively nontoxic" to honeybees. The guideline requirement is fulfilled.

b. Toxicity to Aquatic Animals

(1) **Freshwater Fish**

In order to establish the toxicity of a pesticide to freshwater fish, the minimum data required on the technical grade of the active ingredient are two freshwater fish toxicity studies. One study should use a coldwater species (preferably the rainbow trout), and the other should use a warmwater species (preferably the bluegill sunfish).

Freshwater Fish Acute Toxicity Findings					
Species	% A.I.	LC_{50} ppm a.i.	MRID No.	Toxicity Category	Fulfills Guideline Requirement
Bluegill sunfish	90	0.31	GS0120-042	"highly toxic"	Y
Bluegill sunfish	88.4	0.072	00057846	"very highly toxic"	Y
Fathead minnow	88.4	0.065	Ibid.	"very highly toxic"	Y
Brook trout	88.4	0.034	Ibid.	"very highly toxic"	Y
Rainbow trout	90-100	0.073	GS0144-012	"very highly toxic"	Y
Coho salmon	90-100	0.138	Ibid.	"highly toxic"	Y
Chinook salmon	90-100	0.057	Ibid.	"very highly toxic"	Y
Cutthroat trout	90-100	0.056	Ibid.	"very highly toxic"	Y
Brown trout	90-100	0.080	Ibid.	"very highly toxic"	Y
Lake trout	90-100	0.049	Ibid.	"very highly toxic"	Y
Fathead minnow	90-100	0.200	Ibid.	"highly toxic"	Y
Channel catfish	90-100	0.078	Ibid.	"very highly toxic"	Y
Bluegill sunfish	90-100	0.141	Ibid.	"highly toxic"	Y
Yellow Perch	90-100	0.120	Ibid.	"highly toxic"	Y
Harlequin fish	89	0.300	00034713	"highly toxic"	S

The results of the 96-hour acute toxicity studies indicate that captan is "highly to very highly toxic" to fish. The guideline requirements are fulfilled for testing with technical material.

Data from fish early life-stage tests and life-cycle tests with aquatic invertebrates are required for captan since, for example, it is expected to be transported to water from intended use sites, fish acute LC_{50} values are less than 1 mg/L and EECs in water are equal to or greater than 0.01 of fish and invertebrate acute LC_{50} values.

Previous review determined that the following fish full life cycle study fulfills the requirement for chronic fish testing.

Fish Life-Cycle Toxicity Findings							
Species	% A.I.	NOEL (ppb)	LOEL (ppb)	MATC (ppb)	MRID No. Author/Year	Endpoints Affected	Fulfills Guideline Requirement
Fathead minnow	38.4	16.5	39.5	>16.5 <39.5 (geom. mean = 25.5)	00057846 Hermanutz (EPA), 1973	survival and growth	Y

The results indicate that fathead minnow growth and survival is affected between 16.5 and 39.5 ppb. The guideline requirement is fulfilled.

Additionally, acute formulated product testing with a typical end-use product is required if the end-use pesticide is applied directly to an aquatic environment, or if the technical LC50 is less than or equal to either the maximum expected environmental concentration or the estimated environmental concentration when the end-use pesticide is used according to the label. For captan, the maximum expected environmental concentrations are expected to exceed the lowest technical LC50 for fish.

(2) **Freshwater Invertebrates**

The minimum testing required to assess the hazard of a pesticide to freshwater invertebrates is a freshwater aquatic invertebrate toxicity test, preferably using first instar *Daphnia magna* or early instar amphipods, stoneflies, mayflies, or midges.

Freshwater Invertebrate Toxicity Findings					
Species	% A.I.	LC_{50} (ppm)	MRID NO. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Daphnia magna	Tech.	> 7.1 (48-hr.)	00070751 Boudreau, et. al., 1980	"moderately toxic" or less	S
Daphnia magna	90%	8.4 (48-hr.)	GS0120-041 EPA, 1979	"moderately toxic"	Y
Daphnia magna	Tech.	1.3 (26 hr.)	00002875 Frear & Boyd, 1967	"moderately toxic"	S

There is sufficient information to characterize captan as "moderately toxic" to *Daphnia magna*. The guideline requirement is fulfilled.

Aquatic invertebrate life-cycle testing is required for captan since EECs are expected to exceed 0.01 LC50, for example.

(3) **Estuarine and Marine Animals**

Acute toxicity testing with estuarine and marine organisms is required when an end-use product is intended for direct application to the marine/estuarine environment or is expected to reach this environment in significant concentrations. Captan uses that may result in exposure to the estuarine environment include apples, cherries, pears, turf, and vegetables.

The requirements under this category include a 96-hour LC_{50} for an estuarine fish, a 96-hour LC_{50} for shrimp, and either a 48-hour embryo-larvae study or a 96-hour shell deposition study with oysters, with technical captan. These are currently data gaps.

Testing using formulated products are required, for example, when the EEC $\geq$ LC50. Testing is currently reserved, pending submission and evaluation of technical testing. One inadequate study has been previously reviewed.

Estuarine/Marine Acute Toxicity Findings

Species	% A.I.	LC_{50} (ppm)	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Dungeness crab	50	8 (adjusted for ai)	BA0CAP03 Armstrong, et. al., 1976	"moderately toxic" (based on ai)	S

A guideline requirement would not be fulfilled by this study.

c. Toxicity to Plants

(1) Terrestrial

Currently, Tier 1 terrestrial plant testing (seedling emergence and vegetative vigor) is required for captan due to phytotoxicity label statements.

(2) Aquatic

Currently, aquatic plant testing is required for captan since it has outdoor non-residential terrestrial uses and it may move off-site of application by drift (e.g., it has aerial and air blast applications). The following five species should be tested in Tier 2, due to effects seen in a test with one aquatic species (*Scenedesmus subspicatus*, an algae): *Selenastrum capricornutum*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flosaquae*, and a freshwater diatom. Additionally, any uses involving aerial, air blast, or chemigation application methods wil require spray drift studies under guidelines 200-1 and 202-1.

Tier 2 toxicity data on the technical material is listed below:

Nontarget Aquatic Plant Toxicity Findings

Species	% A.I.	EC_{50}
Scenedesmus subspicatus	92.7	0.32 mg/l

The results indicate that aquatic concentrations of 0.32 mg/l would produce a 50% inhibition in growth for this test species. The guideline requirements are not fulfilled by this one test.

3. Exposure and Risk Characterization

a. Ecological Exposure and Risk Characterization

Explanation of the Risk Quotient (RQ) and the Level of Concern (LOC): The Levels of Concern are criteria used to indicate potential risk to nontarget organisms. The criteria indicate that a chemical, when used as directed, has the potential to cause undesirable effects on nontarget organisms. There are two general categories of LOC (acute and chronic) for each of the four nontarget faunal groups and one category (acute) for each of two nontarget floral groups. In order to determine if an LOC has been exceeded, a risk quotient must be derived and compared to the LOC's. A risk quotient is calculated by dividing an appropriate exposure estimate, e.g. the estimated environmental concentration, (EEC) by an appropriate toxicity test effect level, e.g. the LC_{50}. The acute effect levels typically are:

-EC_{25} (terrestrial plants),
-EC_{50} (aquatic plants and invertebrates),
-LC_{50} (fish and birds), and
-LD_{50} (birds and mammals)

The chronic test results are the:

-NOEL (sometimes referred to as the NOEC) for avian and mammal reproduction studies, and either the NOEL for chronic aquatic studies, or the Maximum Allowable Toxicant Concentration (MATC), the geometric mean of the NOEL and the LOEL (sometimes referred to as the LOEC) for chronic aquatic studies.

When the risk quotient exceeds the LOC for a particular category, risk to that particular category is presumed to exist. Risk presumptions are presented along with the corresponding LOC's.

Levels of Concern (LOC) and associated Risk Presumption

Mammals, Birds

IF THE	LOC	PRESUMPTION
acute RQ >	0.5	High acute risk
acute RQ >	0.2	Risk that may be mitigated through restricted use
acute RQ >	0.1	Endangered species may be affected acutely

chronic RQ >	1	Chronic risk, endangered species may be affected chronically,

Fish, Aquatic invertebrates

IF THE	LOC	PRESUMPTION
acute RQ >	0.5	High acute risk
acute RQ >	0.1	Risk that may be mitigated through restricted use
acute RQ >	0.05	Endangered species may be affected acutely
chronic RQ >	1	Chronic risk, endangered species may be affected chronically

Plants

IF THE	LOC	PRESUMPTION
RQ >	1	High risk
RQ >	1	Endangered plants may be affected

Currently, no separate criteria for restricted use or chronic effects for plants exist.

(1) **Exposure and Risk to Nontarget Terrestrial Animals**

(a). Birds

Residues found on dietary food items following captan application may be compared to LC_{50} values to predict hazard. The maximum concentrations of residues of captan which may be expected to occur on selected avian or mammalian dietary food items following both a single and multiple foliar application rates are provided in the tables below. Residues per lb ai applied for the four food types are developed from Hoerger and Kenaga (1972) and Kenaga (1973), with modifications suggested by Fletcher, et. al. (1994); the "broadleaf plants" category includes forage and is considered applicable to small insects while the "fruits" category includes seeds and is considered applicable to large insects (E. Fite, pers. comm./internal draft, 2/23/95).

For avian acute risk, there are no definitive risk quotients since definitive LC50s are not available (i.e. no mortality reported at the highest test levels). Similarly for avian chronic risk, no effects were reported at the highest test level. However, EECs sometimes exceed these levels. Avian dietary and reproduction testing at higher exposures would be needed to provide definitive risk quotients.

Avian EECs -- Single Application*			
Use Site	**Applic. rate**	**Food item**	**EEC (ppm)**
Turf**	43.56**	short grass	10,454
		long grass	4,792
		broadleaf plants	5,881
		fruits	653
Almonds	5.25***	short grass	1,260
		long grass	578
		broadleaf plants	709
		fruits	79
Apples	4.5	short grass	1,080
		long grass	495
		broadleaf plants	608
		fruits	68
Peaches Nectarines	4	short grass	960
		long grass	440
		broadleaf plants	540
		fruits	60
Pears Plums/fresh prunes Strawberries	3	short grass	720
		long grass	330
		broadleaf plants	405
		fruits	45
Apricots Blueberries	2.5	short grass	600
		long grass	275
		broadleaf plants	338
		fruits	38
Cherries Grapes	2	short grass	480
		long grass	220
		broadleaf plants	270
		fruits	30

*foliar sites and rates from HED Table (except as noted)
**turf maximum rate from 9/94 LUIS report
***as per E. Wilson, RD (1/13/95 ccmail message)

As can be seen in the above table, even a single application to turf at the high rate shown can result in residues that exceed those in available LC50 tests. To evaluate the risk of such residues, LC50 tests with the two preferred test species, mallard and northern bobwhite, should be conducted at test levels above 5000 ppm to produce definitive LC50s. For the other sites shown, maximum residues from a single application are below the no-mortality levels for all species tested and are thus unlikely to result in avian mortality from dietary exposure.

Similarly, avian reproduction testing was conducted to 1000 ppm, with no effects reported. Risk assessment at higher exposures (e.g., even a single application for apples, almonds, or turf) would require testing at higher concentrations.

For multiple applications, a FATE model is used to estimate residues based on accumulation due repeat applications at a given interval and degradation due to estimated foliar dissipation. Since actual foliar half-life data are not available, the dissipation "half-life" estimate by EFGWB is an approximation, based partly on dislodgeable residue information from OREB. Actual dissipation is not expected to be linear, but instead related mainly to rainfall (P. Mastradone and A. Jones, personal communication).

Avian EECs -- Multiple Applications*					
Use Site	Applic. rate	No. of applics.	Applic. interval (days)	Food item	EEC(ppm) max.
Almonds	5.25**	5**	5***	short grass	3,368
				long grass	1,545
				broadleaf plants	1,895
				fruits	211
Apples	4.5	7	7	short grass	2,532
				long grass	1,161
				broadleaf plants	1,425
				fruits	159
Peaches Nectarines	4	8	3	short grass	3,921
				long grass	1,797
				broadleaf plants	2,205
				fruits	245
Pears Plums/fresh prunes Strawberries	3	9	7	short grass	1,714
				long grass	786
				broadleaf plants	964
				fruits	107
Apricots Blueberries	2.5	14	7	short grass	1,439
				long grass	660
				broadleaf plants	811
				fruits	91
Cherries Grapes	2	7	3	short grass	1,865
				long grass	855
				broadleaf plants	1,049

				fruits	117

*foliar sites and rates from HED Table (except as noted); number of applications (based on maximum seasonal rates) and application intervals are for underlined crops. Estimated foliar "half-life" used is 9 days (P. Mastradone/A. Jones, pers. comm., 3/1/95, see discussion above).
**as per E. Wilson, RD (1/13/95 ccmail message)
***as per E. Wilson, RD (3/6/95, pers. comm.)

For the sites evaluated, estimated residues resulting from multiple applications at the maximum rates and minimum intervals are below the no-mortality level in all but one avian LC50 test (this one exception had a highest test level of 2400 ppm, with no mortality). It thus appears unlikely that these dietary residues would result in avian mortality. Turf is not included since the 9/94 LUIS report did not indicate whether turf has repeat applications or if so, how many. Since even single turf applications at the maximum rate exceed maximum test levels, as seen earlier, any repeat applications would obviously exceed it further (and thus, the additional acute testing noted above would be needed for risk assessment).

As noted earlier, to assess reproductive risk at exposures over 1000 ppm would require testing at higher levels. With multiple applications, all sites have estimated maximum residues on one or more food items that exceed this level.

(b) **Mammals**

Small mammal exposure is addressed using acute oral LD_{50} values converted to estimate a LC_{50} value for dietary exposure. The estimated LC_{50} is derived using the following formula:

$$LC_{50} = \frac{LD_{50} \text{ x body weight (g)}}{\text{food cons. per day (g)}}$$

Small Mammal Food Consumption in PPMs (Based on an LD_{50} = mg/kg)				
Small Mammal	**Body Weight in Grams**	**% of Weight Eaten Per Day**	**Food Consumed Per Day in Grams**	**Estimated LC_{50} Per Day in PPMs**
Meadow vole	46 gms	61 %	28.1 gms	2226 ppm
Adult field mouse	13 gms	16 %	2.1 gms	8419 ppm
Least shrew	5 gms	110 %	5.5 gms	1236 ppm

The above table is based on information contained in Principles of Mammalogy by D. E. Davis and F. Golley, published by Reinhold Corporation, 1963.

The estimated LC_{50} is then compared to the residues listed above to calculate a risk quotient (EEC/LC_{50}). The "estimated LC50" in these calculations can be considered as the concentration of toxicant in a day's diet, lethal to 50% of a test population (E. Fite, pers. comm.). The table below indicates the risk quotients for each of the indicated application rates.

Mammal Risk Quotients* -- Single Application

Use Site	Applic. rate	Small mammal	Risk Quotient
Turf**	43.56**	meadow vole	4.7
		field mouse	0.07
		least shrew	4.8
Almonds	5.25***	meadow vole	0.56
		field mouse	0.009
		least shrew	0.57
Apples	4.5	meadow vole	0.49
		field mouse	0.008
		least shrew	0.49
Peaches Nectarines	4	meadow vole	0.43
		field mouse	0.007
		least shrew	0.44
Pears Plums/fresh prunes Strawberries	3	meadow vole	0.32
		field mouse	0.005
		least shrew	0.33
Apricots Blueberries	2.5	meadow vole	0.27
		field mouse	0.004
		least shrew	0.27
Cherries Grapes	2	meadow vole	0.22
		field mouse	0.004
		least shrew	0.22

*foliar sites and rates from HED Table (except as noted)

The current standardized models are as follows:

- -meadow vole consuming short grass
- -adult field mouse consuming seeds
- -least shrew consuming forage and small insects

**turf maximum rate from 9/94 LUIS report

***as per E. Wilson, RD (1/13/95 ccmail message)

For single applications, the high acute LOC is exceeded for turf and almonds. The restricted use and endangered species acute LOCs are exceeded for all sites modelled. Chronic LOCs would therefore be exceeded for all the rates evaluated, since the lowest chronic toxicity values are considerably lower than acute values.

Mammal Risk Quotients -- Multiple Applications*

Use Site	Applic. rate	No. of applics.	Applic. interval (days)	Small mammal	Risk Quotient
Almonds	5.25**	5**	5***	meadow vole	1.5
				field mouse	0.025
				least shrew	1.5
Apples	4.5	7	7	meadow vole	1.1
				field mouse	0.019
				least shrew	1.2
Peaches Nectarines	4	8	3	meadow vole	1.8
				field mouse	0.029
				least shrew	1.8
Pears Plums/fresh prunes Strawberries	3	9	7	meadow vole	0.8
				field mouse	0.013
				least shrew	0.8
Apricots Blueberries	2.5	14	7	meadow vole	0.6
				field mouse	0.011
				least shrew	0.7
Cherries Grapes	2	7	3	meadow vole	0.8

				field mouse	0.014
				least shrew	0.8

*foliar sites and rates from HED Table (except as noted); number of applications (based on maximum seasonal rates) and application intervals are for underlined crops. Estimated foliar "half-life" used is 9 days (P. Mastradone/A. Jones, pers. comm., see discussion above). The current standardized models are as follows:

-meadow vole consuming short grass
-adult field mouse consuming seeds
-least shrew consuming forage and small insects

**as per E. Wilson, RD (1/13/95 ccmail message)
***as per E. Wilson, RD (3/6/95, pers. comm.)

With repeat applications, the high acute risk, restricted use, and endangered species acute LOCs are exceeded for all sites modeled. Chronic LOCs would therefore be exceeded for all the rates evaluated, since the lowest chronic toxicity values are considerably lower than acute values.

(2) **Exposure and Risk to Nontarget Aquatic Animals**

Expected Aquatic Concentrations: Captan displays very high toxicity to most fish species tested. EFED calculated generic EEC levels based on runoff from a 10 hectare field to a 1 hectare x 2 meter deep water body. These generic EEC's (GEEC's) take into account degradation in the field prior to a rain event. They were calculated for turf, since EFGWB was not able to produce a refined EEC for this site.

A refined EEC is included here for those use sites that EFGWB was able to model. This EEC is determined using environmental fate and transport computer models. The Pesticide Root Zone Model (PRZM2) was used to simulate pesticides in field runoff and the Exposure Analysis Modeling System (EXAMS II) to simulate pesticide fate and transport in an aquatic environment (one acre body of water).

ESTIMATED ENVIRONMENTAL CONCENTRATIONS (EECs) FOR CAPTAN*							
Crop	Application Method	Application Rate in lbs a.i./A (No. of applics.)	Initial EEC (ppb)	4-day EEC (ppb)	21-day EEC (ppb)	60-day EEC (ppb)	90-day EEC (ppb)
Turf	foliar	43.56 (1)	623.0	163.1	31.1	11.7**	———
Almonds	spray blast	5.25 (6)	216.8	56.6	14.5	10.6	8.2
Apples	spray blast	4.5 (7)	102.0	28.4	6.2	5.0	3.6

Peaches	spray blast	4.0 (8)	546.8	111.2	24.9	17.5	13.4
Prunes	spray blast	3.0 (9)	118.2	30.8	7.9	5.7	4.6
Cherries	spray blast	2.0 (7)	28.0	5.5	2.7	2.3	1.7
Blueberries	spray blast	2.5 (14)	161.0	33.4	8.0	6.5	4.7

*EECs for all sites, except turf, from EFGWB review using PRZM2 and EXAMS II. Turf EECs from GENEEC model developed by EFGWB.

**average 56-day EEC

(a) Freshwater Fish

Risk Quotients (RQ) for Freshwater Fish (LC50 for brook trout, most sensitive species, = 34 ppb; acute RQ = initial EEC/LC50; chronic RQ = geometric mean of fish full life-cycle NOEL and LOEL/ 90-day EEC*)		
Crop/application rate (lb ai/A)	Acute RQ	Chronic RQ
Turf (43.56)	18.3	0.46
Almonds (5.25)	6.4	0.32
Apples (4.5)	3.0	0.14
Peaches (4.0)	16.1	0.53
Prunes (3.0)	3.5	0.18
Cherries (2.0)	0.8	0.07
Blueberries (2.5)	4.7	0.18

*56-day EEC for turf (GENEEC model)

Foliar turf applications and spray blast applications to fruit and nut crops are expected to exceed high acute risk, restricted use, and endangered species LOCs for fish. Chronic risk LOCs are not expected to be exceeded.

(b) Freshwater Invertebrates

Risk Quotients (RQ) for Freshwater Invertebrates (lowest LC50 for *D. magna* = 1300 ppb; acute RQ = initial EEC/LC50; chronic data not available)		
Crop/application rate (lb ai/A)	Acute RQ	Chronic RQ
Turf (43.56)	0.45	NA
Almonds (5.25)	0.17	NA
Apples (4.5)	0.08	NA
Peaches (4.0)	0.42	NA
Prunes (3.0)	0.09	NA
Cherries (2.0)	0.02	NA
Blueberries (2.5)	0.12	NA

The aquatic invertebrate restricted use LOC is exceeded for the following modelled sites: single foliar turf applications and multiple spray blast applications to almonds, peaches, and blueberries. The endangered species acute LOC is exceeded for all modeled sites, except cherries. Chronic effects to aquatic invertebrates cannot be evaluated until submission of chronic toxicity data.

(3) Exposure and Risk to Nontarget Plants

A full plant exposure and risk assessment will await submission of required terrestrial and aquatic plant testing. However, the one available aquatic plant EC50 (for *S. subspicatus*, an alga) is 320 ppb. Comparing this value to the maximum initial aquatic EECs shown earlier indicates that the aquatic plant high risk and endangered species LOCs are exceeded for turf and peaches.

(4) Seed Treatments

Foliar treatments of captan would generally be expected to pose a greater risk to aquatic life because of repeat applications, runoff,and drift, for example. Also, foliar treatments are not soil-incorporated whereas seed treatments would be to varying degrees. EFGWB has indicated that they do not have the capacity to estimate runoff resulting from seed treatments.

In general, seed treatments have the capacity to pose risks to birds since seeds could be attractive as a food item. In the case of captan, however, the chemical is generally in the "practically nontoxic" category for birds, implying low risk. The highest exposure, and thus risk, would appear to be with grass seed. It has, along with several others, the highest labeled rate (9 oz. ai/100 lbs of seed, HED Table). It is also broadcast, as opposed to being placed in furrows. It is also only lightly covered, to allow for germination. This rate translates into approximately 5625 ppm (9/16)/100 on the seeds. If a bird's diet were composed entirely of treated seeds, the residues would be slightly higher than the highest test level in most dietary studies, where no mortality was seen. Thus, while a major risk seems unlikely, testing at higher levels would be needed to complete a full risk assessment.

(5) **Risk Characterization of Captan Degradates/Metabolites**

EFGWB has identified a number of degradates/metabolites for captan in its 9/7/93 review. These include THPI and THPAm. The EFGWB review notes "that residues of THPI and THPAm may be present in soil several months following captan application" and that they "may move with surface runoff". Current toxicity data are mostly with technical captan. To the degree that captan degrades/metabolizes during studies, the toxicity of these chemicals would be partially reflected by the study results. The Agency needs to evaluate what additional testing specifically on degradates/metabolites may be needed to complete a risk assessment.

(6) **Endangered Species**

The Endangered Species Protection Program is expected to become final in 1995. Limitations in the use of captan will be required to protect endangered and threatened species, but these limitations have not been defined and may be formulation specific. EPA anticipates that a consultation with the Fish and Wildlife Service will be conducted in accordance with the species-based priority approach described in the Program. After completion of consultation, registrants will be informed if any required label modifications are necessary. Such modifications would most likely consist of the generic label statement referring pesticide users to use limitations contained in county Bulletins.

Literature Citations

Fletcher, J., J. Nellessen, and T. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residues on plants. Environmental Toxicology and Chemistry 13(9): 1383-1391.

Hoerger, F. and E. Kenaga. 1972. Pesticide residues on plants: correlation of representative data as a basis for estimation of their magnitude in the environment. Pp. 9-28 in Coulston, F. and F. Koste (eds.), Environmental quality and safety, vol. 1, Academic Press, New York.

Kenaga, E. 1973. Factors to be considered in the evaluation of the toxicity of pesticides to birds in their environment. Pp. 166-181 in Coulston, F. and F. Koste (eds.), Environmental quality and safety, vol. 2, Academic Press, New York.

Date:
Case No: 0120
Chemical No: 081301

PHASE V
DATA REQUIREMENTS FOR CAPTAN
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
6 Basic Studies in Bold					
71-1(a) Acute Avian Oral, Quail/Duck	TGAI	ABCHIKLM	yes	MRID GS0120-045 GS9999-001 00020560 00151236	no
71-1(b) Acute Avian Oral, Quail/Duck	(TEP)				
71-2(a) Acute Avian Diet, Quail	TGAI	ABCHIKLM	yes	MRID 00022923 00104686	yes[3]
71-2(b) Acute Avian Diet, Duck	TGAI	ABCHIKLM	yes	MRID 00022923	yes[3]
71-3 Wild Mammal Toxicity					
71-4(a) Avian Reproduction Quail	TGAI	ABCK	yes	MRID 00098295 00104083	yes[4]
71-4(b) Avian Reproduction Duck	TGAI	ABCK	yes	MRID 00098296	yes[4]
71-5(a) Simulated Terrestrial Field Study					
71-5(b) Actual Terrestrial Field Study					
72-1(a) Acute Fish Toxicity Bluegill	TGAI	ABCHIKLM	yes	MRID GS0120-042 GS0144-012 00034713 00057846	no
72-1(b) Acute Fish Toxicity Bluegill	(TEP)	ABCK	no		yes[5]
72-1(c) Acute Fish Toxicity Rainbow Trout	TGAI	ABCHIKLM	yes	MRID 00057846 GS0144-012	no
72-1(d) Acute Fish Toxicity Rainbow Trout	(TEP)	ABCK	no		yes[5]
72-2(a) Acute Aquatic Invertebrate Toxicity	TGAI	ABCHIKLM	yes	MRID 00070751 GS0120-041 0002875	no

* In Bibliographic Citation column indicates study may be upgradeable

Date:
Case No: 0120
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PHASE V
DATA REQUIREMENTS FOR CAPTAN
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
72-2(b) Acute Aquatic Invertebrate Toxicity	(TEP)	ABCK	no		no
72-3(a) Acute Estu/Mari Tox Fish	TGAI	ABCK	no		yes[4]
72-3(b) Acute Estu/Mari Tox Mollusk	TGAI	ABCK	no		yes[5]
72-3(c) Acute Estu.Mari Tox Shrimp	TGAI	ABCK	no		yes[6]
72-3(d) Acute Estu/Mari Tox Fish	(TEP)	ABCK	no		reserved[7]
72-3(e) Acute Estu/Mari Tox Mollusk	(TEP)	ABCK	no		reserved[7]
72-3(f) Acute Estu/Mari Tox Shrimp	(TEP)	ABCK	no		reserved[7]
72-4(a) Early Life Stage Fish	TGAI	ABCK	yes	MRID 00057846	no/reserved[8]
72-4(b) Life-Cycle Aquatic Invertebrate	TGAI	ABCK	no		yes/reserved[9]
72-5 Life-Cycle Fish	TGAI	ABCK	yes	MRID 00057846	no
72-6 Aquatic Org. Accumulation					
72-7(a) Simulated Aquatic Field Study					
72-7(b) Actual Aquatic Field Study					
122-1(a) Seed Germ./Seedling Emerg.	TGAI	ABCK	no		yes[10]
122-1(b) Vegetative Vigor	TGAI	ABCK	no		yes[10]
122-2 Aquatic Plant Growth	TGAI	ABCK	no		no
123-1(a) Seed Germ./Seedling Emerg.	TGAI	ABCK	no		reserved[11]
123-1(b) Vegetative Vigor	TGAI	ABCK	no		reserved[11]
123-2 Aquatic Plant Growth	TGAI	ABCK	partially	Acc. No. 252566	yes[12]
124-1 Terrestrial Field Study					

* In Bibliographic Citation column indicates study may be upgradeable

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PHASE V
DATA REQUIREMENTS FOR CAPTAN
ECOLOGICAL EFFECTS BRANCH

ata Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
24-2 Aquatic Field Study					
41-1 Honey Bee Acute Contact	TGAI	ABCK	yes	MRID 00080871 05001991	no
41-2 Honey Bee Residue on Foliage					
41-5 Field Test for Pollinators					

* In Bibliographic Citation column indicates study may be upgradeable

1.Composition: TGAI = Technical grade of the active ingredient; PAIRA = Pure active ingredient, radiolabeled; TEP = Typical end-use product

2.Use Patterns: A = Terrestrial Food Crop; B = Terrestrial Feed Crop; C = Terrestrial Non-Food Crop; D = Aquatic Food Crop; E = Aquatic Non-Food Outdoor; F = Aquatic Non-Food Industrial; G = Aquatic Non-Food Residential; H = Greenhouse Food Crop; I = Greenhouse Non-Food Crop; J = Forestry; K = Outdoor Residential; L = Indoor Food; M = Indoor Non-Food; N = Indoor Medical; O = Indoor Residential; Z = Use Group for Site 00000

3. Additional testing is needed at > 5000 ppm to support uses with EECs exceeding 5000 ppm (e.g., foliar turf and certain high-rate seed treatments). A definitive LC50 will enable calculation of definitive risk quotients.

4. Available avian reproduction studies support uses for exposures up to 1000 ppm. Testing at higher concentrations is needed to assess risk of higher concentrations.

5. TEP testing is needed for those use patterns where EEC $\geq$ LC50.

6. Marine/estuarine testing with TGAI is needed to assess risk for those use sites, including apples, cherries, pears, vegetables, and turf that could involve exposure of marine/estuarine organisms.

7. Testing with TEP(s) is needed to evaluate those use patterns with marine/estuarine exposure where the EEC $\geq$ LC50 with TGAI. Testing is reserved pending submission and review of marine/estuarine testing on TGAI.

8. The fish life-cycle study cited has been previously determined to fulfill the requirement for a freshwater fish early life-stage study. This study is reserved for a marine/estuarine fish species, pending submission and review of acute marine/estuarine testing with TGAI.

9. Although aquatic invertebrates are less sensitive than fish in acute tests with captan, the Agency is now requiring chronic testing for both fish and invertebrates whenever chronic testing is needed (as per approved changes to 40 CFR part 158). For aquatic invertebrates, testing is needed since EECs are $\geq$ 0.01 LC50, for example. Testing is reserved for marine/estuarine species pending submission of acute testing with TGAI.

10. Tier 1 terrestrial plant testing (seedling emergence and vegetative vigor) is required for captan due to phytotoxicity label statements.

11. Tier 2 terrestrial plant testing is reserved, pending submission and review of Tier 1 testing.

12. Aquatic plant testing is required for captan since it has outdoor non-residential terrestrial uses and it may move off-site of application by drift (e.g., it has aerial and air blast applications). The following five species are required, in Tier 2, due to effects seen in a test with one aquatic species (*Scenedesmus subspicatus*, an algae): *Selenastrum capricornutum*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flosaquae*, and a freshwater diatom. Additionally, any uses involving aerial, air blast, or chemigation application methods will require spray drift studies under guidelines 200-1 and 202-1.